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Approved by:

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ABSTRACT

Construction of a new highway or an interchange has a significant impact on the land value of the properties in proximity because of the resulting improved accessibility and therefore increased use. A new interchange is proposed on Interstate 71 north between Exit-19 (Fields-Ertel Road) and Exit-20 (Western Row) in Deerfield Township, Warren County, Ohio. The principle reason behind this proposal is to ease the high level of traffic congestion on Fields-Ertel Road highway interchange (I-71, Exit-19). Despite general business, and office/warehouse zoning many of the parcels in the areas adjoining the proposed interchange, remain vacant because of poor access. The proposed interchange would provide better access and likely increase the land value of the parcels.

The principle aim of the present study was to analyze the potential increase in land value of identified vacant parcels resulting from the interchange construction and compare it against the actual costs incurred in building the interchange. Increase in land value of vacant parcels is calculated by subtracting the current value from a projected value estimated using regression models. A list of recommendations were compiled that would facilitate the execution of the project and other planning decisions related to land use allocation and subdivisions of parcels in Deerfield Township.

The land value of the study is estimated to increase by $59.95 million. This is a significant increase in land value, which is not only associated with new interchange but also associated with change in land use. Out of the total increase of $59.95 million, the land value is estimated to increase by $9.84 million as a result of new interchange and $50.11 million as a result of the change in land use. These results are based on the assumptions that the change in land use will occur without the new interchange, which is unrealistic because the new land use plan has been prepared considering the new interchange. Therefore, the actual increase in land value attributed to new interchange may be more than $9.84 million. The total estimated interchange cost estimated to vary between $22.83 million to $32.83 million. The property value for all types of uses in Deerfield Township are highly associated to corner lot, providing further research direction to understand how the benefits of a corner lot can be achieved through better design and development practice.

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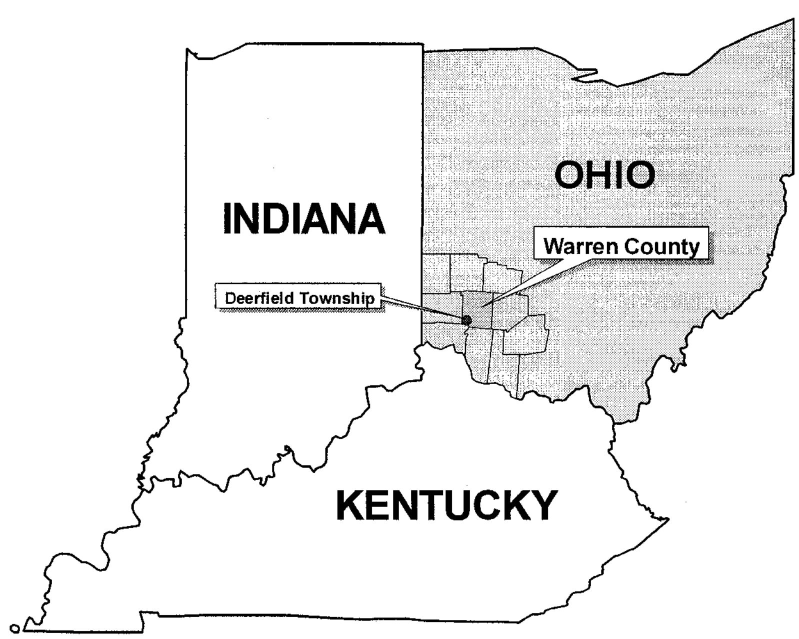
CHAPTER 1: INTRODUCTION

Deerfield Township is situated in the southwestern quadrant of Warren County, Ohio and shares the boundary with Hamilton County to the south and Butler County to the west as shown in Figure 1.1. It has approximately 26,000 residents and 954 business establishments. According to 2000 Census, the population of Deerfield Township has increased by 70% from 1990 to 2000. Deerfield Township is now the largest community

Figure 1.1: Location Map

Deerfield Township, Warren County, Ohio.



Source: ESRI

in Warren County and one of the fastest-growing communities in Ohio. The township has immediate access to Interstate 71 and is less than two miles from I-75 to the west and I-275 to its south. Located 18 miles from downtown Cincinnati along I-71, proximity to the city and major highways has made Deerfield Township a preferred site for business establishments to locate and expand.

1.1 Problem Statement

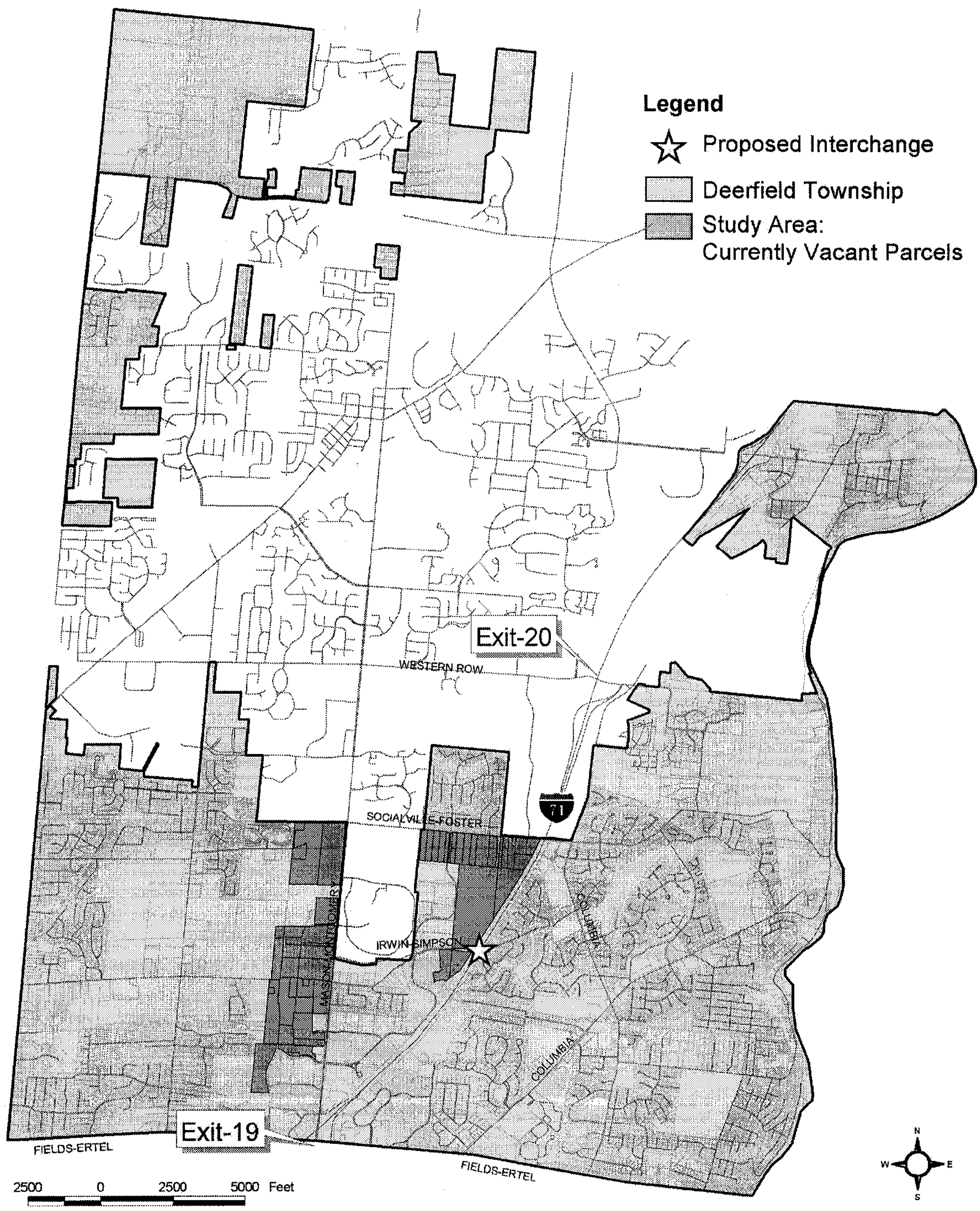
A highway interchange is proposed between Exit-19 (Fields-Ertel) and Exit-20 (Western Row) on I-71 in Deerfield Township, Warren County, Ohio. The proposed location for the new interchange is shown in Figure 1.2. Township officials have anticipated the need of a new highway interchange because of high levels of traffic congestion at the Fields-Ertel Road highway interchange (I-71, Exit-19). The high density of commercial development in close proximity to the Fields-Ertel Road interchange is a major generator of traffic from customers, employees and others using or providing services to local businesses.

The Deerfield Township authorities are proposing a new highway interchange in the region to redirect the traffic towards the area of Irwin-Simpson Road and Mason-Montgomery Road intersection. This interchange is intended to reduce the traffic density at the Fields-Ertel interchange, which in turn would provide better access to the adjacent jurisdictions of Symmes Township, Hamilton Township, West Chester Township, and the City of Mason.

The area where this interchange is proposed consists of many vacant parcels generally located along or near Irwin-Simpson Road and Mason-Montgomery Road. These vacant parcels are currently either used for agricultural purposes or as an open space, parks and for other recreational facilities such as golf course. In spite of, high development potential, these parcels largely remain vacant due to lack of freeway access. For instance,

Figure 1.2: Proposed Location for Highway Interchange

Deerfield Township, Warren County, Ohio.



Source: Warren County GIS Department and Deerfield Township Community Development Department

a large parcel along Irwin-Simpson Road (approximately 200 acres), currently used as a golf course, is privately owned and zoned for "General Business." The township's annual property tax revenue from the golf course is relatively less when compared to what would be received if this land were commercially developed. As per the information provided by township officials, the township officials and the owners of these vacant properties therefore welcome commercial development although most of the residents in the area are not in favor of such development.

The existing land use plan for Deerfield Township generally supports the commercial development on the west side of the proposed interchange. Though the identified vacant parcels in Figure 1.2 are zoned for "general business" and "office/warehouse," they still remain unoccupied because of lack of freeway access. The increasing level of traffic congestion on Exit-19 extending towards the Fields-Ertel Road is a major deterrent for the developmental opportunities of these parcels. A new interchange would provide better access and development opportunities to these parcels. The residents as such are not averse to this development. However, a principal apprehension that most of the residents harbor against any such development is the burden of additional local taxes in the name of future road and infrastructure improvement. Also, there is an increasing concern about possible loss in residential property value owing to interchange impacts. Interestingly, the residents who do not support such development are scattered throughout the township rather than primarily residing near the vacant parcels.

Many issues surround the lower property values and property tax receipts for undeveloped land in contrast to the higher tax receipts from commercially developed land. A key issue is whether receipts are greater in long run than the cost of the interchange and accessory improvements and services. Such interchange development would not only increase property values for commercial properties but also there may be additional value attributable to residential properties if better freeway access is provided.

1.2 Objectives and Expected Outcome

As a part of my thesis, I assessed the change in the land values of currently vacant parcels in light of the proposed new freeway interchange and also compare the increase in land value with total interchange cost. My principal aim was to answer the question: What the dynamics of property values are with and without the proposed highway interchange, and how does the increase in land value attributed to interchange construction compare with the total interchange cost? The land values of the vacant parcels were calculated under two scenarios -- with and without interchange construction. The increase in land value of currently vacant parcels was calculated by subtracting the estimated land value from the projected land value. The estimated land value was calculated based on the assumption that no interchange is constructed while the projected land value assumes construction of the proposed interchange will be complete by 2010.

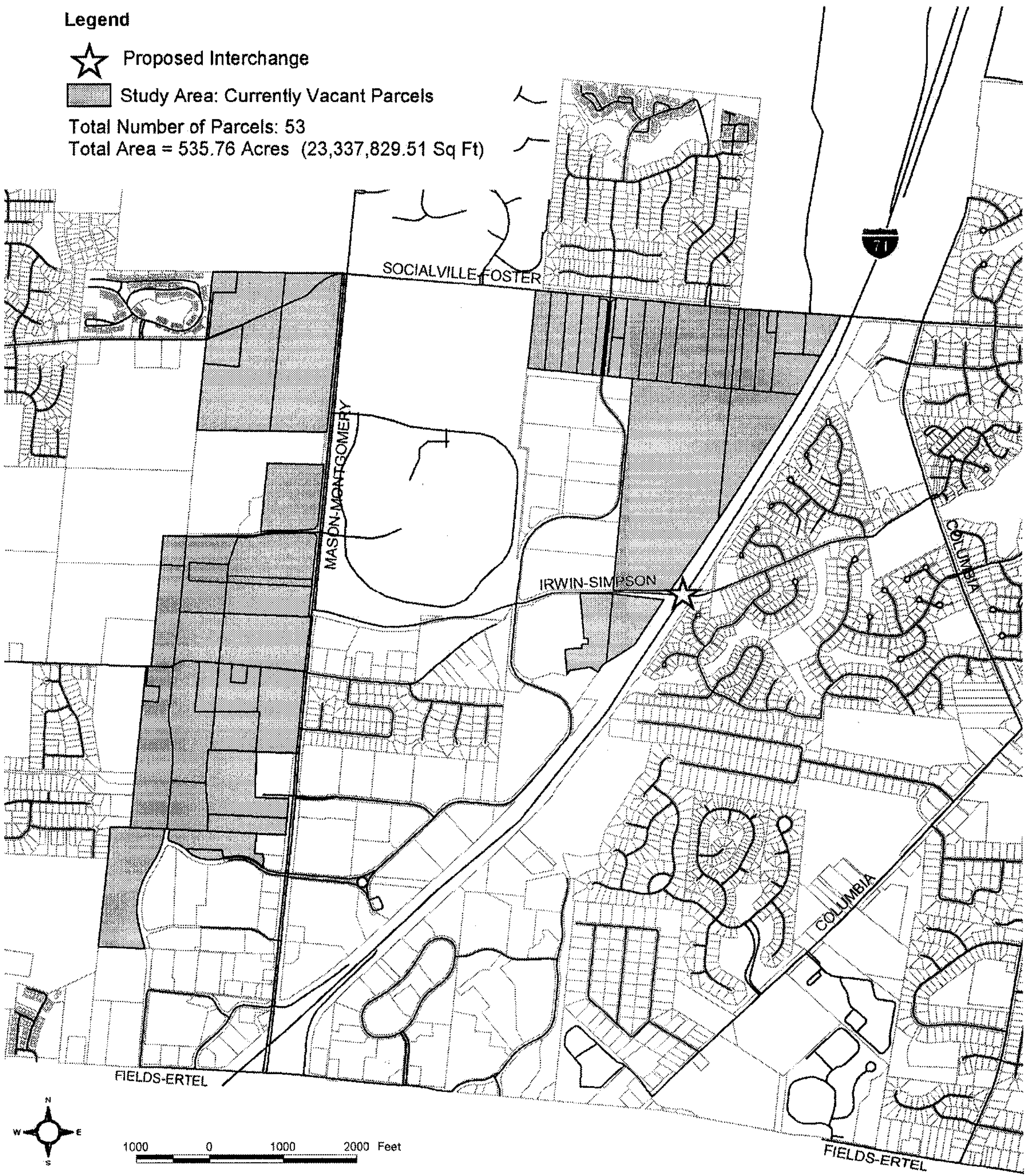
Finally, the increase in land value was compared with the total interchange cost. The total interchange cost includes four components of costs associated with construction of the interchange. These four cost components are: land acquisition, relocation, site clearance, and construction. Land acquisition is the cost to purchase all the properties lying in right-of-way (ROW) of the interchange. Relocation costs include the compensation for relocating property owners or tenants. Site clearance costs are associated with clearing the site for interchange construction by tearing down the existing structures and then removing the debris.

The study area for my research project included all the vacant parcels near the proposed interchange which are mainly located along or near Irwin-Simpson Road and Mason-Montgomery Road as shown in Figure 1.3. All the vacant parcels of study area are located within the jurisdiction of Deerfield Township. Most of these parcels fall under "general business" and "office/warehouse" categories as per the township-zoning map. However, the current land use of these parcels are either agriculture, or open space. Some of the identified vacant parcels in Figure 1.3 are in close proximity to Exit-19 but still remained vacant because the increasing levels of traffic congestion, a major limiting factor, in the development of these properties. The growth is expected on these vacant parcels albeit under the conditions of high traffic congestion but the issue remains in how the increased traffic congestion would be handled in future without adversely affecting the development opportunities of these parcels. Hence, the idea of proposing a new interchange is an auspicious decision, which would boost the development potential as well as provide better access to the residents of Deerfield Township.

A new land use plan was prepared by the Community Development Department of Deerfield Township under consideration that the new highway interchange would be constructed in the future. As a result of improved highway access, the currently vacant parcels will have the potential to develop as commercial, office, office/warehouse, or mixed use properties. In the proposed land use plan, these parcels are categorized for commercial, office, office/warehouse, or mixed use. Certain physical design and transportation issues have also been addressed in my research project. However, the focus remains on an analysis based on the impact on land values in the study area rather than physical design and transportation issues. The physical design and transportation issues were accounted for based on case studies of similar scale interchange projects under similar urban characteristics in Ohio.

I have conducted an economic feasibility analysis of the proposed interchange by comparing the interchange cost and the increase in land value of vacant parcels. An economic feasibility analysis is quite different than a fiscal impact analysis or a cost-benefit analysis. Fiscal impact and cost- benefit analysis are viewed in a very broad perspective of any activity while economic feasibility analysis is more specific. In the actuality there would be a number of benefits and costs associated with freeway interchange. The analysis includes comparison of small portions of benefit and cost associated with the interchange construction. The economic feasibility analysis of the new freeway interchange presented here includes one component of cost that is "interchange cost" and one component of benefit that is "increase in land value of existing vacant parcels," which are located along Irwin-Simpson Road and Mason-Montgomery Road.

Figure 1.3: Study Area



Source: Warren County GIS Department and Deerfield Township Community Development Department

CHAPTER 2: LITERATURE REVIEW

This chapter is divided into two sections. The first section is about the use of regression for land and policy evaluation. The second section of this chapter includes the specifics and details of using GIS for regression modeling.

The first section focuses on the use of regression modeling for land and policy evaluation. It also includes the discussion about different types of variables and their significance. The argument about regression analysis "as a reliable modeling technique for predicting the land value" is defended in this section by presenting similar works related to land and policy evaluation based on general regression assumptions.

2.1 Use of Regression for Land and Policy Evaluation

There have been extensive studies done in the field of land valuation and measuring the effect of state and local fiscal policies on economic development (Anderson and Wassmer 2000). Analyzing property values and property tax revenue is part of such analysis (Beck and Bruce 1993). The methodology adopted for such studies is either simple or multiple regression analysis since many factors directly or indirectly affect land value (Beck and Bruce 1993).

Regression analysis is a tool that derives the relationship between two or more variables. Two variables, X and Y, may be related to each other exactly or inexactly. In the physical sciences, variables frequently have an exact relationship to each other. The simplest such relationship between an independent variable (the "cause"), labeled X, and a dependent variable (the "effect"), labeled Y, is a straight line, expressed in the formula,

$$Y = a + bX,$$

where the values of the coefficients, a and b, determine, respectively, the precise height and steepness of the line. Thus, the coefficient a is referred to as the intercept or constant, and the coefficient b is referred to as the slope (Berry 1993).

Anderson and Wassmer (2000) conducted a study to determine the efficacy of the local economic development incentives in the Detroit Metropolitan area. They used a logit-probit regression model to establish how five economic development incentives (manufacturing abatement, commercial abatements, IDBs, TIFAs, and DDAs) influenced local employment rates, poverty rates, and fiscal variables.

Key measures of the efficacy of local incentives in a metropolitan area are a positive influence on the residential employment rate and/or a negative influence on the poverty rate within a specific community. Their model takes into account the joint relationship of the variables. Variables that are jointly determined in a statistical model are defined as endogenous. There are other factors that come from outside the model and determine the value of endogenous variables; these are defined as exogenous. For example, the value of a city's manufacturing property tax base may be influenced by the manufacturing property tax abatements offered by the city as well as by its geographic size. In this case, the area of the city is an exogenous variable, while the manufacturing tax base is an endogenous variable. The dollar amount of manufacturing property tax abatement offered by a city may also be affected by the dollar amount of city's manufacturing tax base. These two variables are dependent on one another and are thus endogenous. In a metropolitan area, we expect such simultaneous relationships to exist among the local employment rate, poverty rate, property tax bases, fiscal variables, and economic development incentives. "This model is designed in broad enough terms to apply to any U.S. metropolitan area (Anderson and Wassmer 2000)."

Eleven theoretical models, of the exogenous and endogenous variables expected to determine each of the necessary endogenous local relationships, were developed. Anderson and Wassmer (2000) also described the real-world variables used to measure each of the exogenous and endogenous variables. The information was gathered for all 112 communities in the Detroit area over a period spanning nearly 20 years.

Manufacturing property value, one of the endogenous variables, is measured as the real market value of the manufacturing property tax base in a given jurisdiction. Factors that can influence these values are essentially a measure of a jurisdiction's desirability to manufacturing firms. The equation composition for manufacturing property value is given as:

> Manufacturing property value = *f(residential employment rate, poverty rate, manufacturing property tax abatements with time-interactive variables, IDBs with time-interactive variables, municipal expenditure per capita, property tax rate,* percentage population young, percentage population old, percentage population with bachelor's degree, percentage population with less than high school, percentage property in manufacturing, average surrounding property in manufacturing, city dummies, time dummies).

Italic type designates the manufacturing and commercial property tax base variables as endogenously determined. The remaining explanatory variables are exogenous.

Commercial property tax base is determined in a similar way to the manufacturing property value with the exception of emphasis on availability of local land for commercial development. In terms of factors that can influence this equation highly skilled labor, presence of TIF's and DDA's are all important. The equation composition for commercial property tax base is given as:

> Commercial property value = *f(residential employment rate, poverty rate, real commercial property tax abatements with time-interactive variables, TIFA with time-interactive variables, DDA with time-interactive variables, municipal expenditure per capita, property tax rate*, percentage population young, percentage population old, percentage population with bachelor's degree, percentage population with less than high school, percentage population African American, percentage property in commercial, average surrounding property in commercial, average surrounding residential employment, city dummies, time dummies).

The first seven explanatory variables are endogenous. The remaining right-side variables are exogenous.

The effectiveness of the local incentives was determined based on eleven regression models. The coefficients calculated by running these regression models explain the direct, indirect, positive, and/or inverse relationships of dependent and independent variables. Anderson and Wassmer have used a logit-probit model. The advantage of using such a model is that it includes binary functions. Binary functions are useful in conducting analysis where numeric figures are assigned for certain types or categories of data sample (for e.g. male/female categories). In this model, binary functions are used for "City Dummies" and "Time Dummies," which essentially depict the city size and different time periods for data sample.

Diagnosis of the regression model is one of the most important aspects of this methodology. It provides insight into relationships between variables. Such diagnosis is conducted to estimate the impact of a single independent variable on the dependent variable, keeping other dependent variables constant. For example, diagnosis can be used to estimate the effect of adopting TIF policy on local unemployment rate (Man 2001). Let's consider a regression model investigating the effectiveness of TIF policy, which has four variables: one dependent and three independent. The dependent variable is "Increase in Property Tax" which is a measure of effectiveness of TIF policy and the other three dependent variables: Unemployment Rate, Land Value, and Sales Tax. Once the regression model is generated using the sample data, regression diagnosis can be conducted to identify how the property taxes changes if the "Land Value" is increased. The regression diagnosis is also performed to identify the combined effect of two dependent variables on independent variable. For instance, there may be weak relationship between: "Unemployment Rate" and "Increase in Property Tax"; and "sale tax" and "Increase in Property Tax" but it might be possible that the combined effect of "Unemployment rate" and "Sale tax" is stronger than their individual effect on "Increase in Property Tax."

The argument about regression analysis "as a reliable modeling technique for predicting the fair market values for different types of land uses and properties" is also supported by an extensive number of articles in "Property Tax Journal" (Gloudemans 1991; Jenses 1988; Gandhi and Rahman 1989). The article provides insight about valid application of these models on different scale geographical areas. These models are designed in broad enough terms to be applicable on any geographical scale. The only contention in application of these models in a small geographical area is the availability of adequate sample data to get a reliable result. A minimum sample size of 30 is generally required for the regression model to provide a reliable result (Blalock 1979).

Regression models for different kinds of land valuation (manufacturing, commercial, residential, etc.) have been developed (Gloudemans 1991; Jenses 1988; Gandhi and Rahman 1989). These models differ in terms of variables of properties' *general characteristics* (lot depth, frontage, area etc.) and *locational characteristics* (proximity to highway, closeness to secondary roads, closeness to park or river, closeness to recreational facilities, closeness to other green areas, etc.). Certain *locational characteristics*, for which precise information or data is not available, can be handled as binary (dummy) variables (Beck and Bruce 1993).

2.2 Use of GIS in Regression Modeling

The use of geographic information systems (GIS) for data analysis and building regression models is an area where there is much intent among planners and researchers

(Frank 1989). The concept of GIS is integration; data collected with respect to a location in space can be combined and shared. GIS manages the space-related information ranging from the description of utility lines, description of legal parcels, and land use data at all scales, to socioeconomic data that are related to towns or counties.

GIS can be used for calculating variables for mathematical modeling. Different extensions are available in GIS, which can be installed with the GIS software's like ArcView 3.2, ArcGIS etc. These extensions allow additional commands over the general commands incorporated in GIS. For e.g. the "network analysis" extension calculates the variables related to travel distance through an existing road network. Such extensions are frequently used in transportation studies and modeling (Frank 1989). As a part of the research project, I will be preparing land value models for different land uses and such models includes location specific dependent variables which are easy to calculate through network analysis in GIS. Location specific variables for a parcel are its land value determinant based upon its location in urban setting, for e.g. distance to CBD, distance to highway interchange, etc (Jensen 1988).

CHAPTER 3: RESEARCH METHOD

This chapter is divided into five sections. The first section starts with an overview of the entire methodology adopted for the analysis and includes the general discussion of impacts of new freeway interchange on the study area. The discussion is extended to elaborate the steps of calculations involved in the analysis. The second section identifies the range of data required for the analysis including their sources and preferred formats.

The third section details all the variables used in the regression analysis. It also includes all the assumptions employed to conduct the analysis. Explanation of each variable; its relevance to the analysis; and method adopted to calculate the variables are discussed in light of available data. The fourth section is about the use of network analysis in GIS for calculations of variables. Two approaches of calculations are discussed in this section. The last section explains the use of Statistical Analysis System (SAS) for developing regression models. It includes discussion about the steps involved in writing scripts for stepwise multivariate regression model, which are used in this analysis.

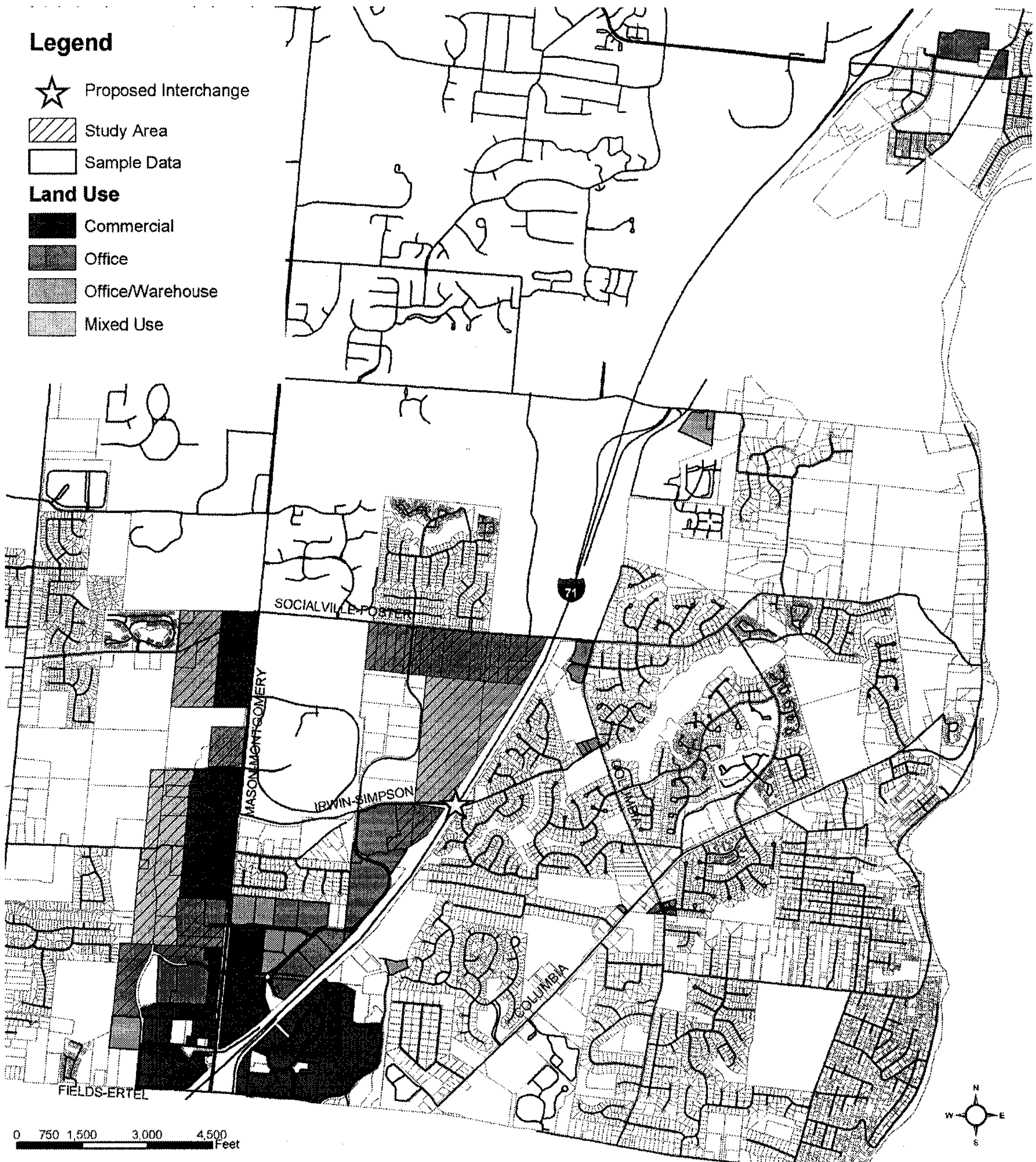
3.1 Methodology

The first step in the methodology process involves the delineation of subject area. The subject area includes study area and the sample data as shown in Figure 3.1. The study area is identified in Figure 3.1 as cross-hatched parcels and includes all the vacant parcels within the boundaries of Deerfield Township near the proposed interchange. These vacant parcels are categorized according to their current land use. Sample data is then identified for respective land uses, which will include all developed parcels within the local jurisdiction of Deerfield Township. Sample data are used to develop regression models, which are then applied to the study area. Figure 3.1 shows the proposed land use for the study area and current land use for the sample data.

A pre-evaluation of vacant parcels (study area) was conducted using their current land values and the land values were inflated for the year 2010, when the construction of the proposed interchange is expected to be complete. This estimate was performed based on the assumption that there will not be any development related to new road construction or highway interchange construction. This estimate reflects the land value of the vacant parcel (study area) for year 2010 under the assumption that no development will take place and all the vacant parcels will remain vacant until 2010. On the other hand, the land values of the vacant parcels are also projected under the assumption that the construction of the highway interchange will be completed by 2010 and the proposed land use plan will also be adopted by then. This projection was done using regression models.

The entire analysis was conducted by comparing the 2001 constant dollar figures because the data received from Warren County auditor's office includes all the land and building values in 2001 dollars. Also, a growth rate of 3% per year is assumed to escalate the land and property values. This growth rate does not reflect the inflation but the growth in land value as a result of general increase in demand because of population growth.

Figure 3.1: Subject Area and Study Area



Source: Warren County GIS Department and Deerfield Township Community Development Department

Real estate investment has a higher rate of return than the equity investments because of this additional "growth factor" (Miller and Geltner 2001). Real estate investor and analyst in the mid-east region of United States uses growth rate of 3% per year for vacant land.

Regression models were developed for different land uses using the respective sample data. The details involved in regression analysis are discussed in Section 3.3 and the results of the same are discussed under Section 4.1. The land values of vacant parcels are projected using the output of the respective regression model. The total increase in the land value of the study area was finally calculated by deducting the estimated land value from the projected land value for all the vacant parcels. The estimated land value was calculated by using current land values escalated to 2010 dollar value and projected land value was calculated using a regression model. Once the increase in the land value is calculated, the interchange cost associated with the construction of new interchange is estimated under different conditions and compared with the increase in the land values of the study area. The interchange cost is estimated based on two limits of construction cost, which vary from $15 million to $25 million. Apart from construction cost, the interchange cost will also include land acquisition, relocation, and site clearance cost. Details of interchange cost are discussed under Section 3.1.2.1 and calculation for the same is performed under Section 4.2.

Figure 3.2 shows the steps involved in the entire research and Figure 3.3 shows the assumed time line for the project. There are numerous types of benefits and costs that are associated with interchange construction, but I am concentrating my analysis by comparing only the increase in land value of currently vacant parcels and the associated interchange cost. The proposed highway interchange will pose two sets of immediate impacts: Physical Impact and Economic Impact.

3.1.1 Physical Impact:

The physical impact includes the physical design aspect of the highway interchange. This aspect of the proposed project was not treated in detail in this study. The focus for the physical impact was on the estimation of land requirements rather than the physical or urban design issues of the highway interchange. In others words, it is the estimation of land acreage needed for the interchange construction following highway construction standards. The data and information required for this portion of work was based on similar interchange construction in Ohio. Other standard figures related to physical impact of interchange construction were also accounted based on similar projects.

Four examples were selected for assessing the interchange's land requirements. These examples were selected on the basis of similarity of geographic location and the scale of interchange. These interchanges are all located either in the Columbus region, or the Cincinnati metropolitan area. The following is a list of the interchange with their approximate location:

- Easton on I-270 north of I-70 and east of I-71
- Tuttle Crossing, along I-270, north of I-70
- Polaris, along I-71, north of I-270
- Union Center on I-75 just north of I-275 in West Chester

Deerfield Township has hired a private consultant (Pflum, Klausmeier and Gehrum Consultants) to prepare the proposed interchange plan. Different options of the interchange plan have been prepared. This plan was used to estimate the land acreage required for the interchange construction.

3.1.2 Economic Impact:

The economic impacts of the proposed freeway interchange includes two basic parts:

- Interchange Cost
- Increase in Land Value of Vacant Parcels

3.1.2.1 <u>Interchange Costs</u>:

Interchange costs include the expenditure associated with the interchange development. There will be four types of expenditures:

- Land Acquisition (compensation for the parcels in the right-of-way)
- Relocation Cost (cost associated with relocating businesses or residents)
- Site clearance cost (removing structures from those properties)
- Interchange construction costs

Currently, there are substantial numbers of privately owned parcels lying in the ROW (Right-of-Way) of the proposed highway interchange. The compensation to be paid for properties lying in the ROW was determined by using the Warren County auditor's information on property values. All the properties lying in the ROW were identified based on the most preferred option of interchange plan prepared by the private consultant and their total property value (land and building) was estimated based on the actual auditor values, which are in 2001dollars. Land acquisition costs are then projected for the expected year of acquisition (2006) considering the property value growth rate of 3% per year.

In the City of Cincinnati, the relocation cost is estimated as $20,000 for each property, irrespective of type of property use. The relocation cost calculations estimated by the Ohio-Kentucky-Indiana Regional Council of Government (OKI) and the Ohio Department of Transportation (ODOT) were also reviewed. Site clearance costs were estimated based on local examples and expert opinion from township officials. Standard figures for the freeway interchange construction cost and the percentage of total cost shared by the local jurisdiction was also identified by examples and expert opinion from township officials.

The interchange construction cost is estimated to be between $15 million to $25 million. This estimate is acquired from expert's opinion and township officials. Finally, the total interchange cost is calculated by adding all four types of expenditures and the total interchange cost will have two limits, upper and lower, due to the two (minimum and maximum) construction cost estimates.

3.1.2.2 Increase in Land Value of Vacant Parcels (Study Area):

The land value of vacant parcels located along Irwin Simpson Road and Mason Montgomery Roads are expected to increase as a result of the new freeway interchange construction and adoption of the township's proposed land use plan, both of which are expected to be complete by 2010. The current land values of the vacant parcels are obtained from GIS data provided by the Warren County GIS department. The current land value of all the vacant parcels are added and then escalated to 2010 figure by using growth rate of 3% per year.

The projected land value is calculated by using regression models for different land uses. A regression model was used to assess the land value of different land uses as a result of the new freeway interchange. The dependent variable is the land value per square feet for a specific type of land use. The independent variables are those factors that influence the land value, for e.g. *proximity to major highway, size of plot, frontage, adjacent land use* etc. Two types of independent variables are used in the model:

- Property-Specific: These variables are the geometric characteristics of the property, which influences its value (Gandhi and Rahman 1989). Following is the property specific variable used for the regression model: *lot shape*.
- Location-Specific: These variables are also called locational variables and are land value determinants based upon its location in the urban setting (Gandhi and Rahman 1989; Jensen 1988). An urban setting is defined as the facilities and utilities that are provided to properties at any place or city. These facilities and utilities include ranges of activities and services, which are provided by the

government and private service providers. Following are the location specific variables used for the regression model: *distance to nearest interchange, distance to second nearest interchange, adjacency to CBD, distance to park or recreational facilities, adjacent land use, adjacency to road, corner lot, distance to nearest religious facility, distance to school.*

The form of regression equation will be:

$$Y_i = Q + a_i X_1 + b_i X_2 + c_i X_3 \qquad \text{OR} \qquad Y_i = f(X_1 + X_2 + X_3)$$

Where, Y_i represents land value per square feet based on land use category "i." X_1, X_2, and X_3 are the independent variables that are different for each land use. Q is the intercept and a_i, b_i, and c_i are the coefficients, which are calculated by running the regression on the sample data. The sample will consist of all parcels of land use category "i" in Deerfield Township, which are developed within the last five years. Once the coefficients a_i, b_i, and c_i are obtained, Y_i (Land Value/Sqft) can be calculated by inserting the values of independent variable (X_1, X_2, and X_3). The values of these independent variables are obtained from the land use plan for the parcels of the land use category "i." All the dependent variables are calculated based on the GIS data provided by the Warren County GIS department. Certain extensions of Arc View GIS like network analysis and spatial analysis are used to calculate the location specific variables using the "road network" of the township. The advantage of using network analysis is that it calculates the travel distance through road network. A statistical package, SAS was used to perform the regression calculations.

Multivariate linear regression analysis was conducted using a stepwise method. A regression model with more than one independent variable is called multivariate regression model (Vonesh and Chinchilli 1997). Stepwise regression generates the model by adding one independent variable after each step. It verifies the effect of the added variable and the combined effect of variables on the model at the end of every step and eliminates the variable if the effect is not statistically significant. Hence, the advantage of using stepwise regression is that the output will be simple and include only those variables that have significant effects on the model (Waissi 2002). Regression diagnostic was conducted to test whether assumptions of the regression model have been substantially violated. The analysis of the regression results were performed to better understand the intensity of relationship between the dependent and independent variables. The diagnosis was also conducted to visualize the effect of single independent variable (keeping other variables constant) on the dependent variable. Correlation coefficients were examined for all the significant variables to analyze the combined effect of two variables. The combined effect of two variables are accounted if the correlation coefficient between any two significant variable is higher than 0.5. The residual plots of variables are used to identify the spread of variables and if any transformation in variable could produce a better result.

The same steps were repeated to generate the coefficients for the Y_i's (Land Value/ Sqft) for different land uses. The land value per square feet for all the vacant parcels were then calculated by substituting all the independent variables in the respective equations. Once the land value per square foot was calculated for individual parcels, the land value of individual parcels were estimated by multiplying value per square foot times area. The total projected land value was then calculated by adding the land values of all the individual parcels.

The total increase in land value is finally calculated by deducting the estimated land value from projected land value. The increase in land value is then compared with the different cost estimates for interchange development. Sensitivity analysis was conducted to assess the sensitivity of the results (dependent variables) to changes in assumptions about the independent variables. This shows how the result would change if the assumptions about land acquisition, or construction costs were 20% higher or lower? Conclusions have been made based on the results obtained by comparing the increase in land value and different interchange cost estimates.

Figure 3.2: Flow Diagram of Methodology

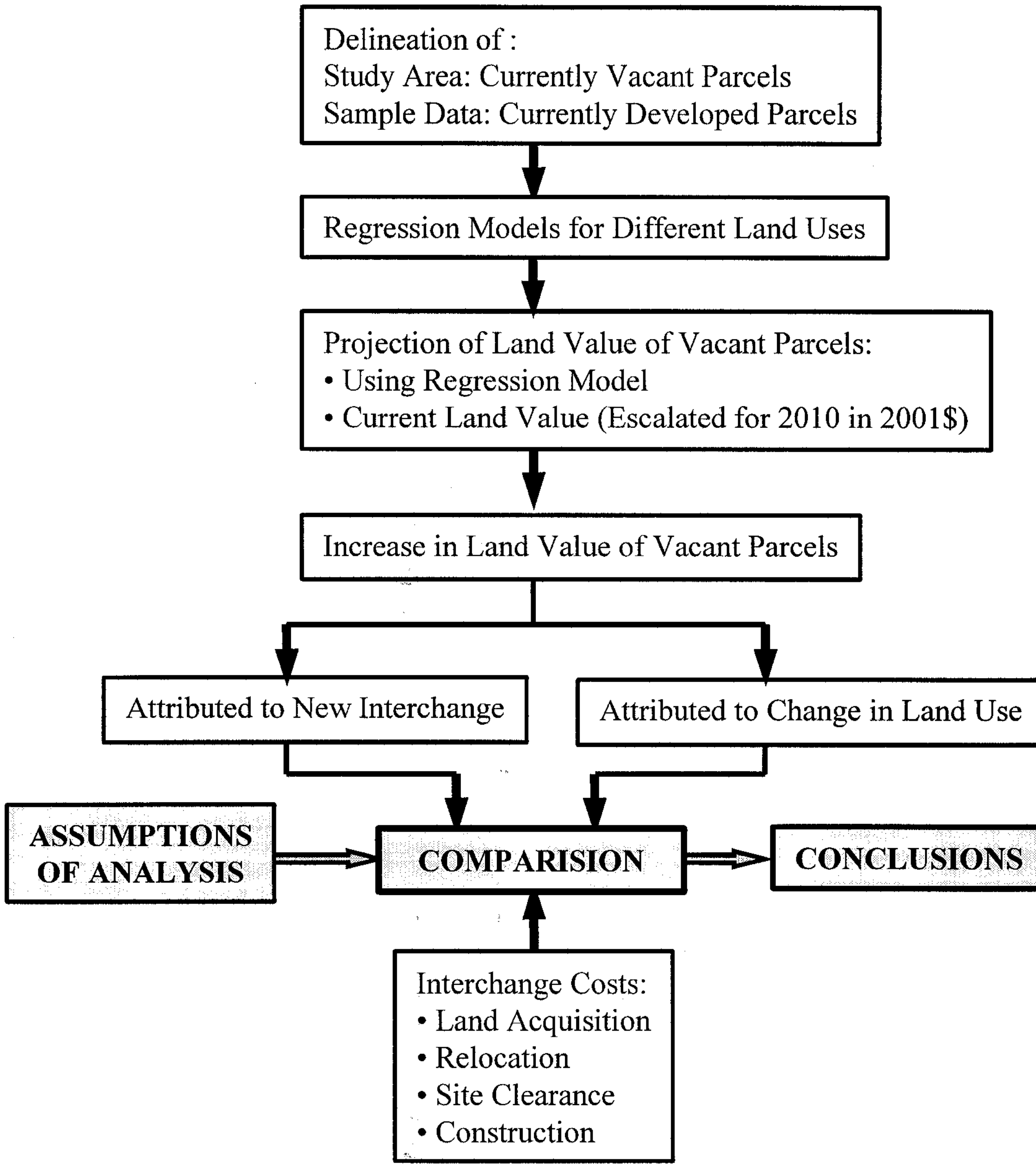
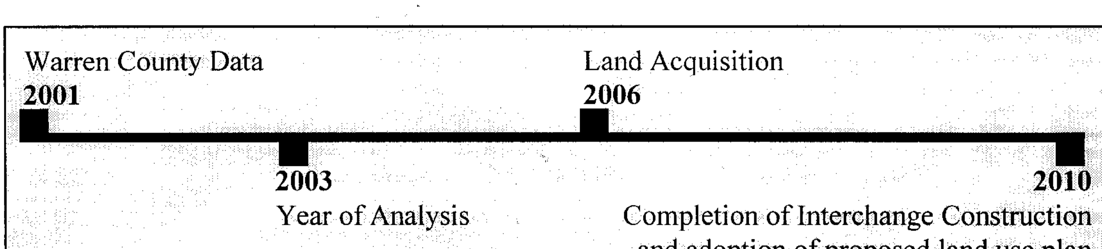


Figure 3.3: Assumed Project Time Line for Analysis



Source: Author

3.2 Data Requirements

A regional map showing the details of the community of interest was required initially to delineate the study area. The parcel information for the study area was gathered from the Warren County GIS department and County auditor's office. Data related to highway interchange construction was based on the actual cost of building similar interchanges in Ohio. As mentioned earlier, general estimates were gathered from case studies about the physical impacts (acreage of land usage) associated with highway interchange.

Most of the data required was available in the GIS format. The property value and building value information are included in the Warren County GIS database. The parcel information for all the properties lying in the study region was also available in GIS form allowing the area analysis to be conducted. Road network and transportation information was also in the GIS format. The current land use plan of Deerfield Township prepared by the township zoning department was also required in the GIS format in order to calculate the land use area for parcels in the study region. The regression models were developed using the current properties that were developed within last five years. Finally, the existing land use plan of the community will be needed for regression analysis.

The major source for most of the data will be Warren County auditor's office and the county GIS department. The county web site does provide the general information for each parcel. Below is the list of data required and their sources:

Figure 3.4: List of Data Requirement

DATA REQUIRED	SOURCES
Regional map to delineate the study area	Deerfield Township: Community Development Department or Warren County GIS Department
Highway interchange construction	Case Study/ Transportation Department (e.g.OKI)
Acreage of land	
Construction expenditure	Expert/ Township official's opinion
Proposed Interchnage Plan prepared by private consultant	Community Development Department of Deerfield township or Private Consultant (PKG)
GIS DATA	County GIS department, County Auditors Office, and Community Development Department of Deefield Township
Parcel information of study area	
Land and property values of all the parcels of local jurisdiction	
Existing Road Network	
Proposed Land use plan	
Information of the properties developed within last five years	
Existing land use	

Source: Author

3.3 Analysis

Two regression models were developed using the sample data as identified in Figure 3.5. The first model was developed for commercial properties only and the second model was developed for office, office/warehouse, and mixed use properties. The reason for combining three different land uses (Office, Office/Warehouse, and Mixed Use) for the second model was that there were too few properties in individual land uses to meet the minimum sample size criterion of 30 for estimating the regression model. The study area includes all the parcels that are currently vacant near the proposed freeway interchange. The sample data included all parcels that were developed and zoned with the same land use as that of the study area. Figure 3.5 shows the vacant parcels (study area) and the two sets of sample data (commercial; office, office/warehouse, mixed use). The two sets of sample data are used to build the regression models. The two models are used to project the land value of vacant parcels. The projected land value of vacant parcels will reflect the land values as a result of the new interchange and proposed land use plan under similar urban setting in future.

There are many different issues and concerns that arise in reality, which affect the land value, and it is difficult to account for all the possibilities in an analysis. Certain assumptions are developed to simplify the analysis but this also limits the generalization of the results (Berry 1993). Below is the list of assumptions that are employed to conduct the analysis for this project:

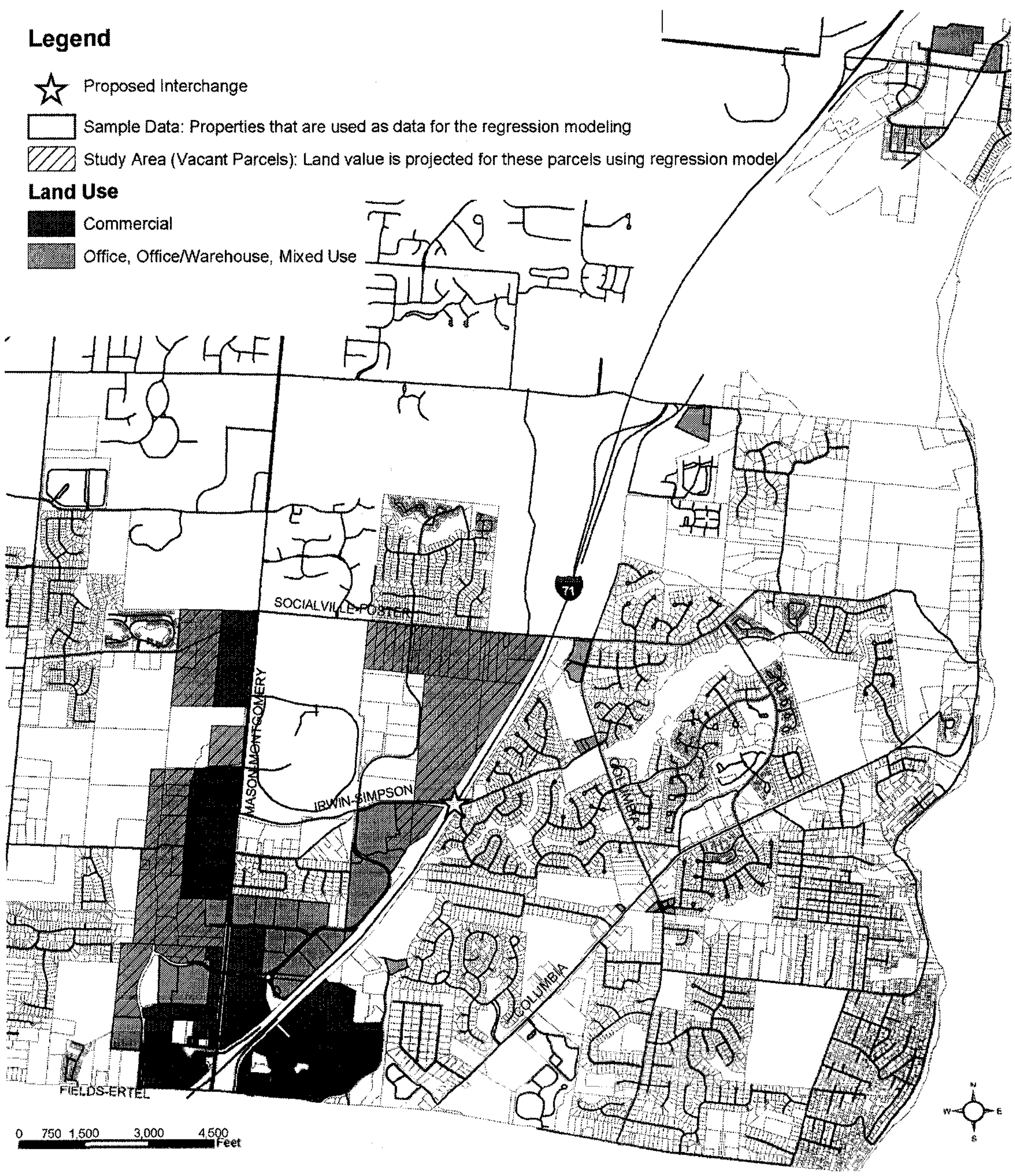
- All the vacant parcels will develop as that of existing developed parcels of same land use. Similar kinds of businesses are expected to locate in the future on the currently vacant parcels.
- The construction of the freeway interchange and the adoption of the township land use plan will be completed by 2010 and the required land acquisition will take place in 2006.
- There will not be any change in the land use plan until 2010 and also there will not be any further land subdivision until then.
- There will not be any development related to construction of new roads or widening of existing roads other than the construction of the proposed interchange and the widening of Irwin Simpson until 2010.
- All the properties will have equal benefits in terms of services and facilities other than the termed variables.

One dependent variable and ten independent variables were used to generate regression coefficients for the two models. The ten independent variables include five real variables and five dummy variables. Real variables are the distances from the property to facilities (Recreational, Highway Interchange, Religious Facility, School, Park) and were calculated using "*Arc View Network Analyst*." They are often referred to as locational variables. The advantage of using the network analysis is that it allows calculation of the driving distance from a property to any facility through the existing road network.

The other five dummy variables are organized by assigning a figure between 0,1,and 2 for each sample or property, 2 being the highest priority and 0 being the lowest priority.

Figure 3.5: Properties used for Regression Model

Deerfield Township, Warren County, Ohio.



Source: Warren County GIS Department and Township Community Development Department

The dummy variables are used for nominal scale variables where no exact definition or specified method of calculation is given for the variable, e.g. lot shape (Blalock 1979).

The shape or the geometry of a parcel is highly associated with its land value but it is very difficult to calculate or estimate an individual figure representing "lot shape" for hundreds of parcels. In such cases some standards are made, like frontage/depth ratio and parcels are categorized into few intervals and a numeric value is assigned to each interval. A numeric value "1" was assigned to all parcels with frontage/depth ratios between 0.5 and 0.25. A numeric value "2" was assigned to other parcels with frontage/depth ratio between 10.0 and 0.5. This technique reduces the complicacy of calculating the individual values for such variable without degrading the effect of the variable in the regression model (Hardy 1993). The eleven variables (1 dependent + 10 independent variables) that are used for both the models are listed below:

3.4.1 Dependent Variable:

- Land value per square foot

3.4.2 Independent Variables:

- Distance to the nearest interchange
- Distance to the second nearest interchange
- Adjacency to Central Business District (CBD) [Dummy Variable, Scale 0-2]
- Adjacency to Road [Dummy Variable, Scale 0-2]
- Lot Shape [Dummy Variable, scale 0-2]
- Corner Lot [Dummy Variable, scale 0-2]

- Adjacent land use [Dummy Variable, Scale 0-2]
- Distance to nearest park or recreational facility
- Distance to nearest religious facility
- Distance to nearest school

Land value per square foot: This is a dependent real variable. It is calculated in US dollars to three decimal figures by dividing land value (only land value, not property value because property value includes land value plus the building or the structure cost) by the area of the parcel (in square feet). The advantage of using such a ratio as a dependent variable instead of just "land value" is that here we can reduce one independent variable ("area") in our model.

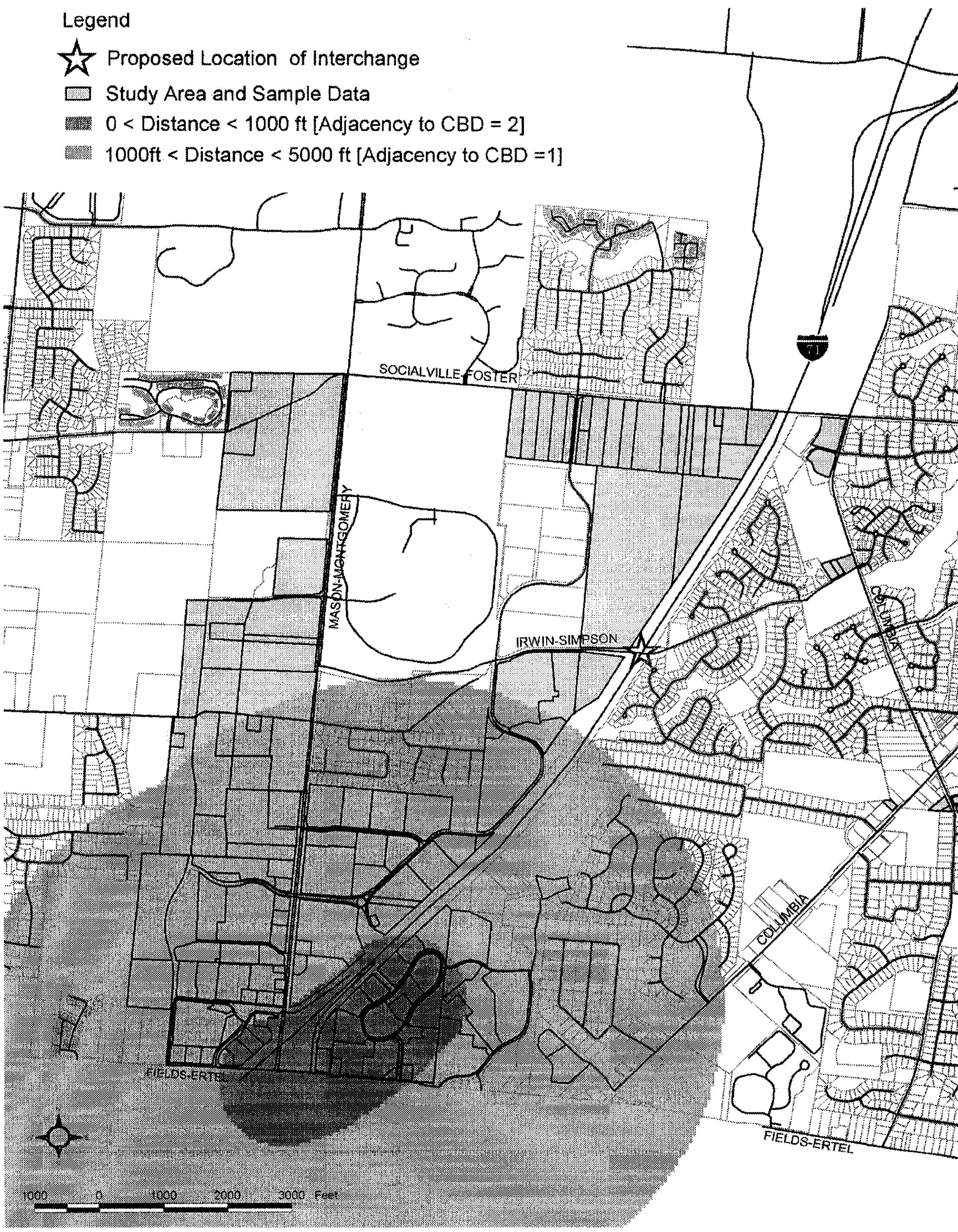
Distance to Nearest Interchange: This is an independent real variable. It is calculated in feet up to three decimal figures by using GIS network analysis. This variable is calculated differently for the sample data and for the vacant parcels. For all the sample data (data that is used to generate the model), this variable is calculated with existing interchanges only and without taking into account of any influence of the proposed interchange on these properties. However, for the vacant parcels (parcels on which the generated models are applied) the proposed interchange is considered while calculating this variable.

Distance to the Second Nearest Interchange: This is also an independent real variable. It is also calculated in feet up to three decimal figures by using GIS network analysis. The assumption about the proposed interchange is exactly the same as that of above variable ("Distance to Nearest Interchange").

Adjacency to Central Business District (CBD): This is an independent dummy variable with scale from 0 to 2. The CBD area in Deerfield Township is considered the area at the intersection of Fields Ertel and Mason Montgomery Roads, which is also the business district nearest to the I-71 Exit-19 interchange. This CBD extends towards northeast, where the Kings Mall and Kings Automall is situated. The numeric value "2" is assigned to all the properties that are within 1000 ft of the CBD. A "1" is assigned to all properties that are within 5000 ft but more than 1000 ft from CBD and "0" to all other properties that are more than 5000 ft away from CBD area. Figure 3.6 shows the calculation procedures *for adjacency to CBD* variables for all the parcels of study area and sample data.

Adjacency to Road: This is also an independent dummy variable with scale from 0 to 2. There are different grades of roads in any urban setting and the land value of any parcel is highly correlated with the kind of access to the property (Heikkila, 2000; Gloudemans, 1991). If a parcel is situated next to an expressway or highway it will have a better access compared to other parcel, which has access from local neighborhood roads. The land value of the parcel located near the expressway will be much higher than the land value of a parcel located in interior of any neighborhood, other factors held constant. All the parcels, which are adjacent to Mason-Montgomery Road and Fields-Ertel Road, are considered to have the highest level of access and were assigned numeric value "2." Other properties which have access from secondary roads are assigned the numeric value "1" and the parcels which are currently subdivided but do not have direct access were assigned "0."

Figure 3.6: Adjacency to Central Business District (CBD)



Source: Warren County GIS Department and Deerfield Township Community Development Department

Lot Shape: This is also an independent dummy variable with scale from 0 to 2. Lot shape has a strong impact on land value because a good geometrical shape of a parcel provides different design options for its use (Hardy 1993). As explained earlier that it very difficult to define and assign individual values to different types of lot shapes. As a consequence, frontage/depth ratio has been used as a proxy for lot shape. The frontage and depth are the physical characteristics of a parcel that can be calculated for every parcel and so their ratio is used as a proxy for lot shape. The numeric value "2" is assigned to all the parcels which have frontage/depth ratio greater than 0.5 and less than 10. Similarly the numeric value "1" is assigned to all the parcels for which frontage/depth ratio is either greater than 10 or it is between 0.5 and 0.25. For all other parcels that have a frontage/depth ratio less than 0.25 or have an irregular geometrical shape, the numeric value "0" is assigned.

Corner Lot: This is also an independent dummy variable with scale from 0 to 2. A corner lot has an advantage of access from two different roads, crating a significant difference in land value between a corner lot and adjacent properties, all other factors being constant. This factor is very important for property uses such as commercial, office, and retail compared to residential or other private uses (Gloudemans 1991). There are different grades of roads in any urban setting ranging from high-speed expressways to narrow neighborhood streets. If a property is located at the intersection of two major roads then its land value will be higher than property located at the junction of neighborhood streets, even though both are corner lots. All the corner properties, which are located adjacent to at least one major road, are assigned the numeric value "2" and "1" to all other corner lots. "0" is assigned to all the parcels that are not corner lots.

Adjacent Land Use: This is also an independent dummy variable with scale from 0 to 2. Adjacent land use of any property has an impact on the land value of that property depending on whether or not the adjacent land use will serve to benefit of the existing property (Man 2001; Anderson and Wassmer 2000). As a general principle it is understood that if retail or commercial businesses are clustered they flourish more because of a coupling effect (Anderson and Wassmer 2000). When the parcels of the same land use are clustered their land value increases. The numeric value "2" is assigned to all parcels which have two or more adjacent properties with same land use. Numeric value "1" is assigned to those parcels which has only one adjacent property with same land use and "0" to those which does not have same land uses for any adjacent properties.

Distance to Nearest Park or Recreational Facility: This is an independent real variable. It was calculated in feet up to three decimal figures by using GIS network analysis. The Township GIS data included the locations of recreational facility as a point theme and parks as a polygon theme. The reason for using the terms "park" and "recreational facility" is that the Township GIS differentiate the two uses though both serves the same purpose. This variable is calculated as the distance between the centers parcels, represented as a point theme, to the nearest park or the center recreational facility through the road network. Please refer to Section 3.4 for calculation details performed in network analysis.

Distance to Nearest Religious Facility: This is also an independent real variable. It is also calculated in feet up to three decimal figures by using GIS network analysis. The Township GIS data included the locations of all religious facilities (Church, Synagogue etc) as a point theme (centers). This variable is calculated in the same manner as the above variable. Please refer to Section 3.4 for calculation details.

Distance to Nearest School: This is also an independent real variable. It is also calculated in feet up to three decimal figures by using GIS network analysis. This is calculated in the same manner as the variable. Please refer to Section 3.4 for calculation details.

3.4 Network Analysis in GIS

The movement of people, the transportation and distribution of goods and services, and the communication of information all occur through definable network systems. Networks form the infrastructure of the modern world. With network, efficient paths and travel sequences can be determined. For example, a road network can be used to identify the path for delivery of resources from a shop to multiple locations in a city so that the total travel distance can be minimum. One major application of network analysis is found in transportation planning, where the objective might be to find paths corresponding to certain criteria, like finding the shortest or least costly path between two or more locations (Network Analysis, Environmental System Research Institute, Inc. 1994).

Network analysis was used to achieve the major task of this research: calculating variables, especially locational variables. Using network analysis provides benefit as it allows calculating the distance through road network. Following are the variables that are calculated using network analysis:

- Distance to the nearest interchange
- Distance to the second nearest interchange
- Distance to nearest park or recreational facility
- Distance to nearest school
- Distance to nearest religious facility

Two approaches are used to calculate the variables in network analysis: manual approach, and scripting. Figure 3.7 provides an explanation of the use of these approaches under different circumstances.

3.4.1 Manual Approach

This approach is the most reliable because it shows the shortest path selected by the software in thick dark line as shown in Figure 3.7. But, it is also one of the most time consuming procedures as it requires the selection of two points on the network to calculate the distance. The points are selected manually on the network and the "network analyst" automatically calculates the shortest distance between these points. These points are selected one by one and have to be on the network. It does not identify any point, which doesn't lie on the network lines, for example, the parcels are identified as polygons in GIS and the road network passes through the edges of the parcels so it's not possible to calculate the distance from the center of a parcel to any facility using manual approach.

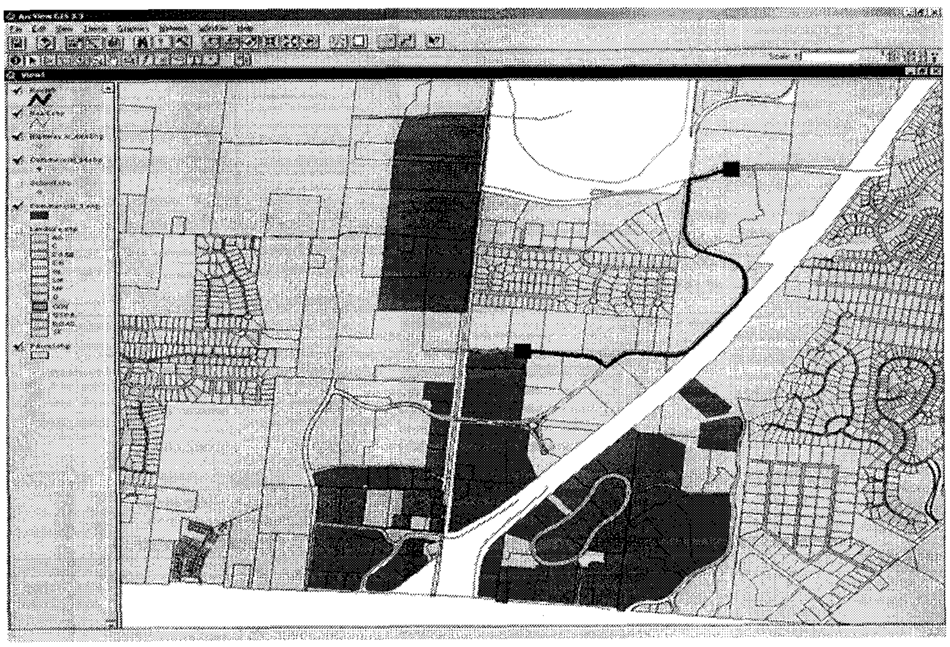
3.4.2 Scripting

This is one of the fastest ways of calculating distance for any set of data. Scripting requires a good quality network GIS file because this method doesn't shows the path but gives the distance figures for all chosen points. Often road network GIS files have breaks in between or double lines for a single road. Scripting approach must be very carefully used if the network file is not of good quality.

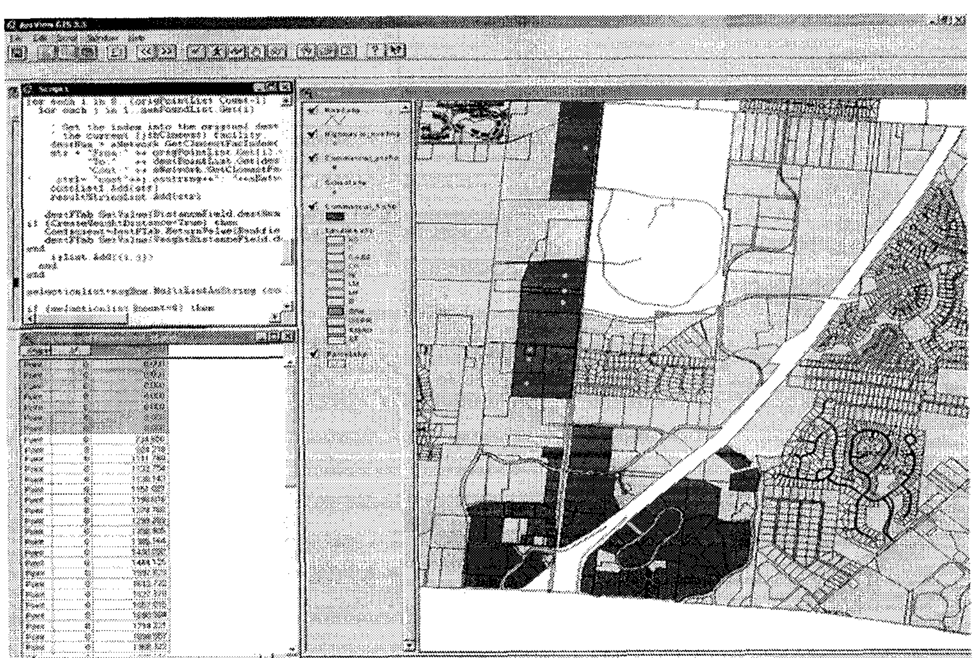
A simple script is written to calculate the distance from one "point shape file" to another "point shape file" through the identified network. The script calculates any number of variables at a time but the input is required in the form of "point" theme. It does not identify the other formats of shape file (line, or polygons). Figure 3.7 shows the "points" that are located at the center of each parcel and identified in a separate "point" shape file. The distance from a facility to all the parcels is calculated simultaneously and automatically tabulated as shown in lower left side of Figure 3.7.

Figure 3.7: Two Approaches of Calculating "Locational Variables" using Network Analysis

Manual Approach:



Scripting:



Source: Author

3.5 Statistical Analysis System (SAS) Modeling

Eleven variables (one dependent and ten independent variables) were used to develop the two regression models. The first model is developed for commercial properties and the second for a combination of three different types of land uses (Office, Office/Warehouse, Mixed Use). The three types of land uses for second model were combined to meet the minimum sample size criterion of 30. Table 7.1.1 in Appendix 1 shows all the variables and their values for the commercial properties model. There are 65 cases. Each row in the table provides information for individual parcels. The column "study area" indicates which data is used to generate the model and which are the ones on which the model was applied. All the vacant parcels are assigned "1" for study area and all the parcels of sample data are assigned "0." The data which have the numeric value "0" for "study area" are used as input for SAS or in other words, are used to generate the model and the model is applied on those parcels which have the numeric value "1" to project their future land value as a result of proposed highway interchange.

As mentioned earlier, increase in land value of currently vacant parcels was calculated by subtracting estimated land value from projected land value. Estimated land value is the current land value of the vacant parcels escalated to 2010 figures and is calculated based on the assumption that there is no change in urban setting and the parcels will remain vacant in future. Projected land value is the land value of the vacant parcels that would be the result of new freeway interchange and adopted land use plan. The projected land value is calculated by using regression models for different land uses.

SAS (ver: 6.12) was used to generate the models through stepwise regression. The significance level of 0.15 is set for stepwise selection criterion and 0.0001 for the entire model. The method of entering one variable at a time and then verifying its effect on the model is called the stepwise regression forward selection procedure (Waissi 2002).

Use of the SAS program is divided into two basic parts as shown in Figure 3.8. First, the model is developed using the forward selection procedure based on the input data. Second, the residual plots and correlation coefficients for all the variables are generated. The residual plot of individual variable shows the spread of that variable along normality. The spread of a variable describes the concentration of values of that variable. If the values are concentrated near the mean there will be small spread. On the other hand, if the values are greatly dispersed then there will be high spread. Examination of residual plots provides insight to whether the regression model's assumption of normality has been violated and transformations are required. The correlation coefficients measure the degree of association between each pair of variables. Correlation coefficients can range in value from –1 to 1. A value of 0 means that there is no association between two variables. In the case of high correlation coefficients, the variables will need to be transformed to combined effects of the highly correlated variable (Lewis and Ford 1979).

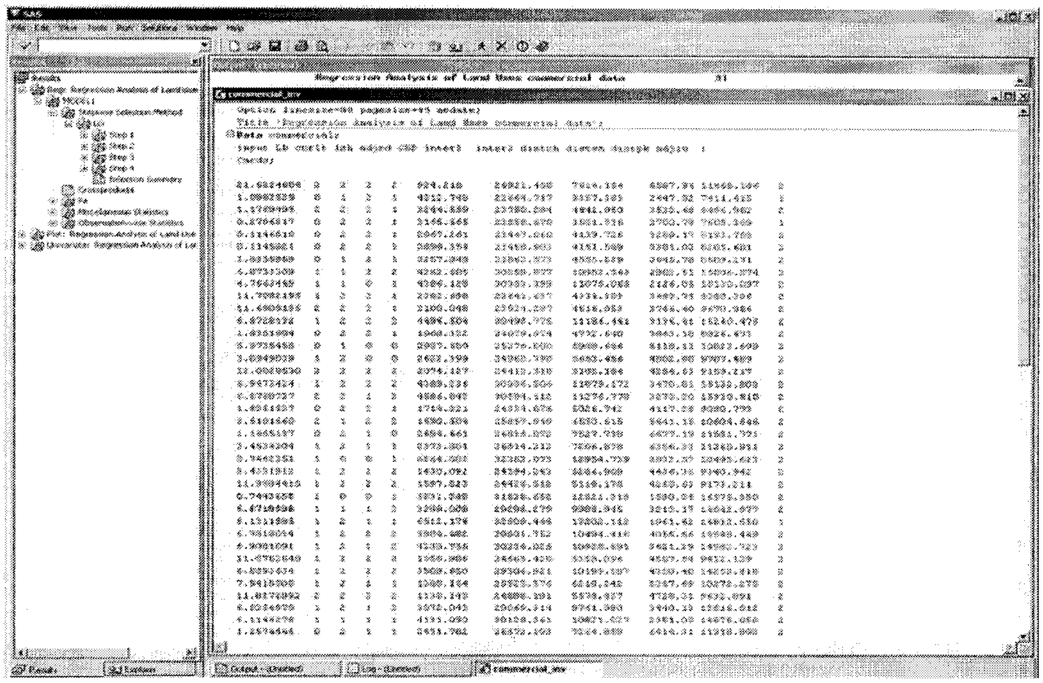
Multivariate linear regression models are developed using stepwise regression. Regression diagnosis is performed after reviewing the residual plots and correlation coefficients of significant variables. Transformations of variables are conducted based on spread of the variable in the initial regression output. The initially generated "multivariate linear regression model" might change to a "multivariate non-linear regression model" depending upon the kind of transformation required for the variables. Sometimes transformation does produce better results but not always. Transformations are used when the R-square of the transformed model is higher than the previous model, or the transformation eliminated violations of regression assumptions (SAS/GRAPH User's Guide: Version 5 Edition 1985).

The residual plots for the commercial properties are attached in Appendix 2. The spread for "Distance to Nearest Highway interchange" deviated widely from the mean. A simple transformation was conducted by reciprocating the variable and multiplying it by 1000. This transformation has resulted in about 3% increase in R-square. The correlation coefficients were all less than 0.5 for the significant variables. Refer to Section 4.1.1 and 4.1.2 for detailed results of regression models for commercial and office, office/warehouse, and mixed use properties respectively. The detailed outputs for the two models are attached in Appendix 2 and Appendix 3 respectively.

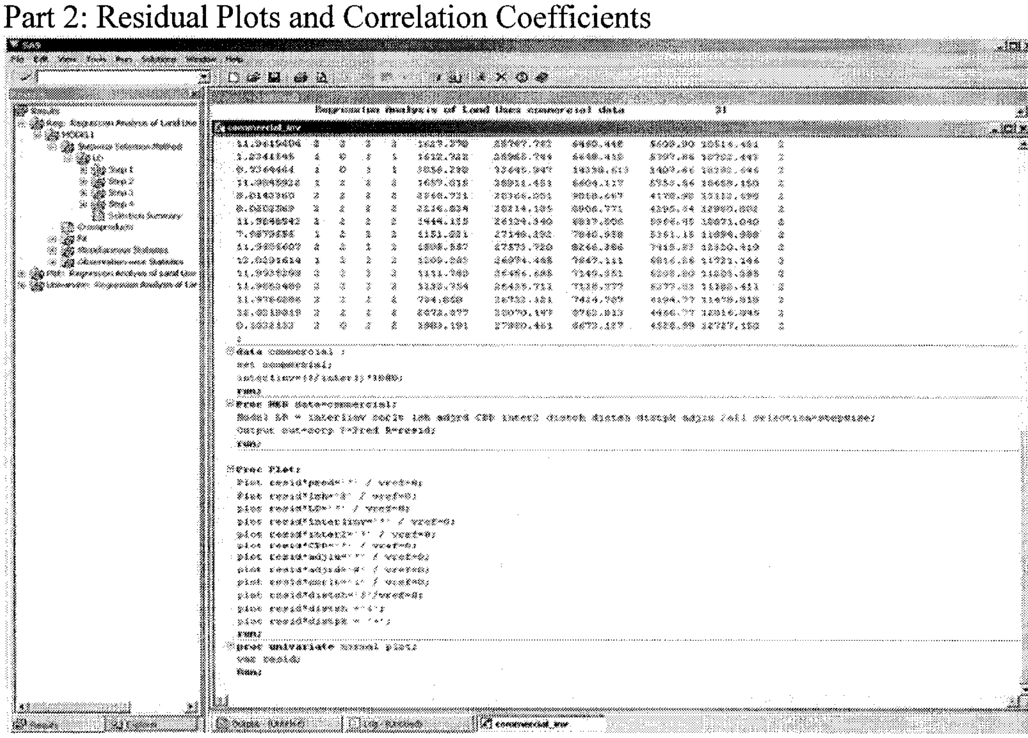
Figure 3.8: Statistical Analysis System (SAS)

The SAS scripting has been divided into two parts:

Part 1: Forward Selection Procedure



Part 2: Residual Plots and Correlation Coefficients



Source: Author

CHAPTER 4: RESULTS

This chapter is divided into three sections. The first section includes the discussion of the two regression results, the projection of land values based on the regression results, and the calculation of increase in land value as a result of proposed interchange. The second section includes the cost estimation related to interchange construction. These costs include the land acquisition cost, site clearance cost, relocation cost, and the interchange construction cost. The last section is about the comparison of increased land values as a result of the new interchange and the estimated interchange construction cost under different scenarios.

4.1 Regressions

4.1.1 <u>Regression Analysis-1: Commercial Properties</u>

A total of 56 observations, the number of existing developed commercial properties, were used to generate a regression model for commercial properties. Figure 4.1 shows the location of the properties used to generate the model and also the vacant parcels on which the output of the model is applied. The variables associated with each of the properties that are shown in Figure 4.1 are tabulated in Table 7.1.1 in Appendix 1. This table is directly used in SAS as data input for regression modeling.

The summary statistics of the dependent variable (Land Value per Sq.ft) are tabulated in Table 4.1. Three properties are commonly used to describe the variables: central tendency, dispersion, and shape. Central tendency refers to an average or typical value for a variable. The concept of central tendency is useful since it allows a single number to stand as a proxy or representative value for all of the data for a given variable. The three most widely used measure of central tendency are the arithmetic mean, median, and mode (Keller and Warrack 2000). The arithmetic mean is defined as the point on the scale for the variable about which the deviations from the mean sum to zero. The mean for land value per sq.ft is 0.0 as shown in Table 4.1 because it is related to t-test where the mean is shifted to 0.0. The median is the position center of the variable. It has exactly half of the observations above it and other half below it. The mode is the most frequently occurring value for the variable (Lewis, Bruce, and Ford 1983).

Table 4.1: Summary Statistics of Dependent Variable (Land Value/Sq.ft) for Commercial Properties

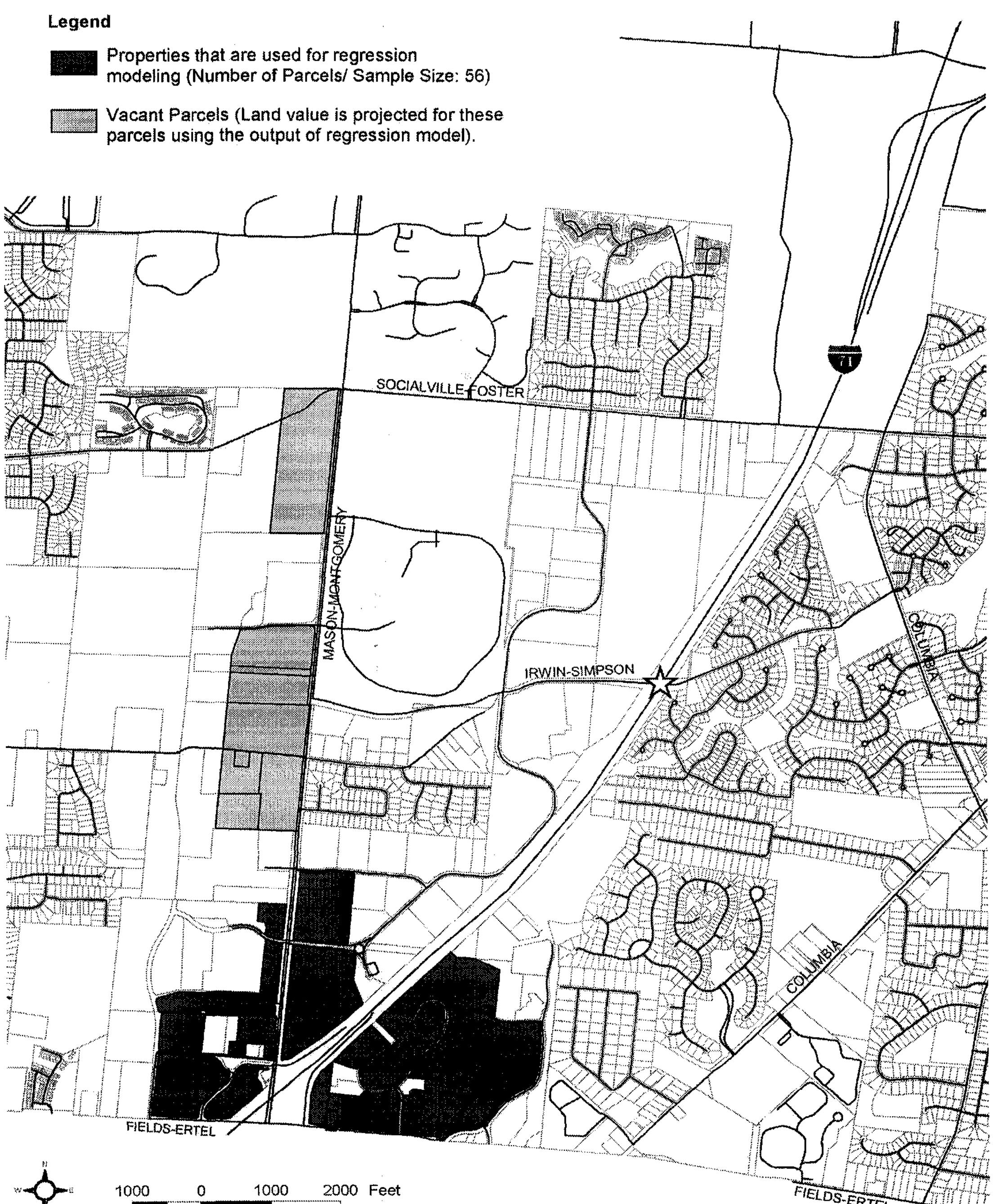
N	56	Std Deviation	2.86745
Mean (t-test)	0.00000	Variance	8.22224
Median	0.24397	Range	14.65578
Mode	_	Interquartile Range	3.73425

Source: Author

Dispersion refers to the spread of the data values with respect to the measure of central tendency. The commonly used measures of dispersion are: the range, standard deviation, and variance. The range is simply the difference between the largest data value and the smallest value and it depicts the distance spanned by the values of the variable. The standard deviation is the average deviation of data value from the variable's mean. It is a measure of dispersion appropriate for use with the mean. The larger the standard deviation, the more dispersed the data or the less concentrated the data is around the mean. The variance is the standard deviation squared and conveys basically the same

Figure 4.1: Properties used for Regression Model and Land Value Projection for Commercial Properties

Deerfield Township, Warren County, Ohio.



Source: Warren County GIS Department and Deerfield Township Community Development Department

information as the standard deviation (Lewis, Bruce, and Ford 1983; Lewis and Beck 1980).

The output of the regression model is tabulated in Table 4.2. The strength of the relationship is determined by examining the R-square statistic associated with the regression equation. R-square, which ranges from 0 to 1, indicates the percent of variance in the dependent variables, which is explained by independent variable. The closer R-square is to 1 the stronger the association between the variables; the close to 0, the weaker the relationship. The R-square statistic, in effect, presents a measure of the usefulness of the regression equation. The model R-Square is about 64%. This means that 64% of variation in *land value per square feet* is explained by the model and rest 36% is

Table 4.2: Summary of Stepwise Regression for Commercial Properties

Model R-Square = 0.6377, F Value = 22.44, Significance Level = 0.0001

Variable	Parameter Estimate	Partial R-Square	Model R-Square	F Value	P Value
Intercept	-4.30910				
Corner Lot	2.22756	0.38600	0.38600	33.94000	0.0032
Lot Shape	2.12757	0.14410	0.53000	16.25000	0.0013
Inter1inv (1000/Distance to nearest interchange)	5.59712	0.08800	0.61800	11.98000	0.0024
Adjacency to CBD	1.45875	0.01970	0.63770	2.77000	0.1020

Source: Author

remained unexplained. Stepwise regression has identified only four significant independent variables at 15% significance level. The program discards all the independent variables that are below 15% significance level in stepwise selection criterion. The model has a significance level of 0.01% that means that all the variables, which have the P-Value greater than 0.0001 are included in the final model.

The parameter estimates and partial R-square of each variable is listed in the first and second column in Table 4.2. This shows that the land value is highly associated with "corner lot" and "lot shape" and "inter1inv." "inter1inv" refers to the "distance to the nearest interchange" variable. There was a transformation conducted for the "distance to the nearest interchange" variable after reviewing the residual plot of this variable. The spread of the residual for this variable was very high, so a transformation was done by reciprocating the variable and multiplying it by 1000. A detailed output of the regression for commercial properties is attached in Appendix 2. Using the parameter estimates of all the significant variables identified in this model, Equation 4.1 is generated. This is the final equation used for projecting land values of all the vacant commercial parcels.

*Land Value/ Sqft = -4.30910 + 2.22756*Corner Lot +*

*2.12757*Lot Shape + 5.59712*1000/(Distance to nearest*

*interchange) + 1.45875*Adjacency to CBD* --------------- Equation 4.1

4.1.2 Regression Analysis-2: Office, Office/Warehouse, and Mixed Use

For the regression model for office, office/warehouse, and mixed-use properties, a total of 37 observations, the number of existing developed commercial properties, were used to generate the model. Figure 4.2 shows the location of the properties that were used to generate the model and also the vacant parcels on which the output of the model is applied. The variables associated with each of the properties that are shown in Figure 4.2 are tabulated in Table 7.1.2 in Appendix 1. This table is directly used in SAS as data input for regression modeling.

The summary statistics of the dependent variable (Land Value per Sq.ft) are tabulated in Table 4.3. The mean for land value per sq.ft is 0.0 as shown in Table 4.3 because it is related to t-test where the mean is shifted to 0.0. The output of the regression model is tabulated in Table 4.4. The strength of the relationship is determined by examining the R-square statistic associated with the regression equation. R-square, which ranges from 0 to 1, indicates the percent of variance in the dependent variables, which is explained by

Table 4.3: Summary Statistics of Dependent Variable (Land Value/Sq.ft) for Office, Office/Warehouse, and Mixed Use

N	37	Std Deviation	1.02203
Mean (t-test)	0.00000	Variance	1.04454
Median	-0.07199	Range	5.25421
Mode	_	Interquartile Range	0.90845

Source: Author

independent variable. The closer R-square is to 1 the stronger the association between the variables; the close to 0, the weaker the relationship. The R-square statistic, in effect, presents a measure of the usefulness of the regression equation.

The model R-Square is about 54%. This means that 54% of variation in *land value per square feet* is explained by the model and rest 46% is remained unexplained. Stepwise regression has identified only three significant independent variables at 15% significance level. The program discards all the independent variables that are below 15% significance level in stepwise selection criterion. The model has a significance level of 0.01% that means that all the variables, which have the P-Value greater than 0.0001 are included in the final model. The parameter estimates and partial R-square of each variable is listed in first and second column in Table 4.4. This shows that the land value is highly associated with "corner lot" and "lot shape" and "distance to second nearest interchange." The negative coefficient for "Distance to Second Nearest Interchange" signifies that the land value decreases if the distance from second interchange increases.

Table 4.4: Summary of Stepwise Regression for Office, Office/Warehouse, and Mixed Use

Model R-Square = 0.5356, F Value = 12.68, Significance Level = 0.0001

Variable	Parameter Estimate	Partial R-Square	Model R-Square	F Value	P Value
Intercept	1.94867				
Corner Lot	0.97970	0.33940	0.33940	17.98000	0.0007
Distance to second nearest interchange	-0.0000971	0.09280	0.43220	5.55000	0.0071
Lot Shape	1.05094	0.10340	0.53560	7.35000	0.0106

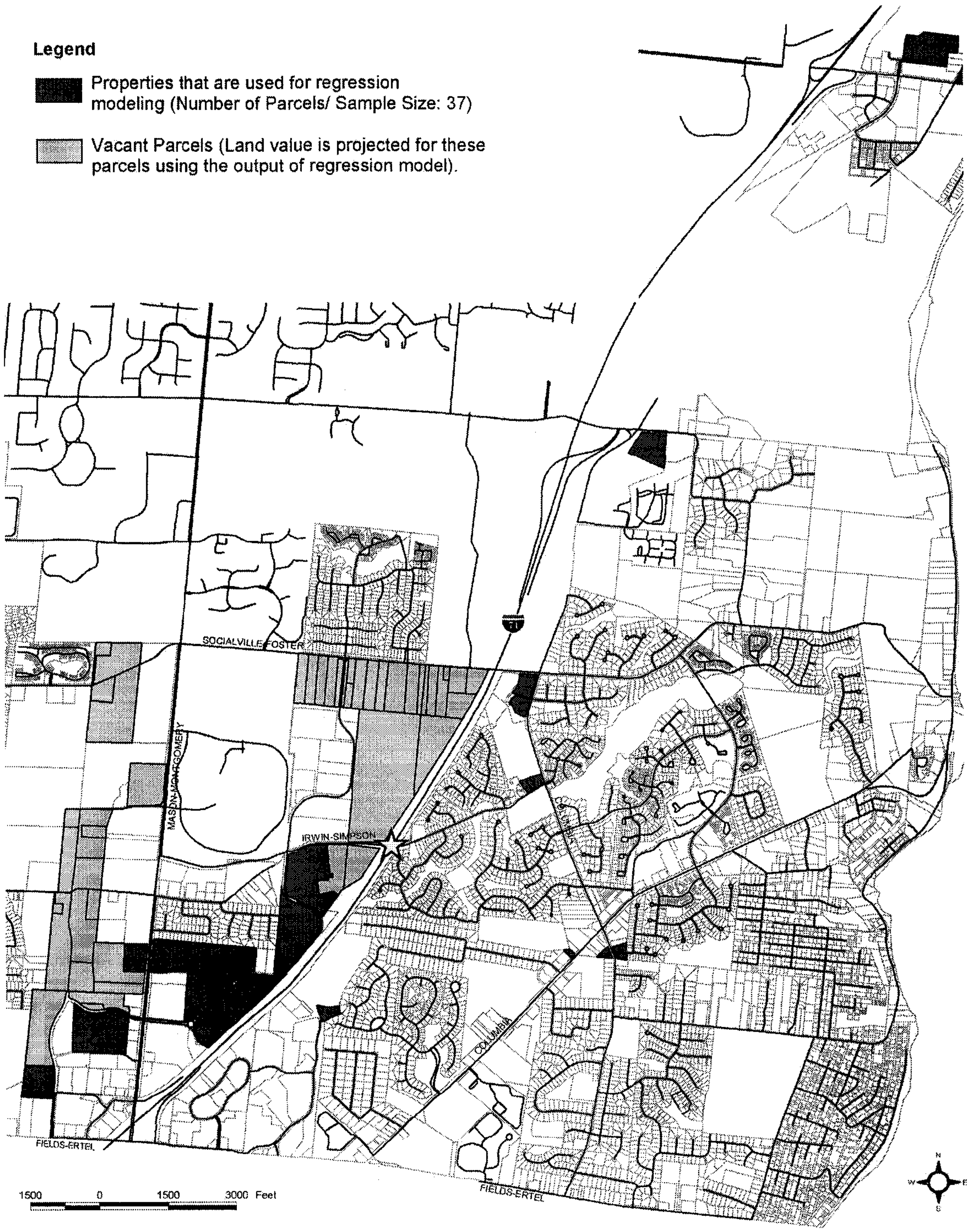
Source: Author

A detailed output of the regression for office, office/warehouse, and mixed-use properties is attached in Appendix-3. Using the parameter estimates of all the significant variables identified in this model, Equation 4.2 is generated. This is the final equation that is used for projecting the land values of all the vacant office, office/warehouse, and mixed-use parcels.

$$\textit{Land Value/ Sqft} = 1.94867 + 0.97970 * \textit{Corner Lot} - 0.0000971 * \textit{Distance to second nearest interchange} + 1.05094 * \textit{Lot Shape} \quad \text{--------------- Equation 4.2}$$

Figure 4.2: Properties used for Regression Model and Land Value Projection for Office, Office/Warehouse, and Mixed Use

Deerfield Township, Warren County, Ohio.



Source: Warren County GIS Department and Deerfield Township Community Development Department

4.1.3 Forecasted Increase in Land Values

The projected land value is calculated for each individual parcel by substituting the values of the variables in the Equations 4.1 and 4.2 depending on its land use. The projected land values for the two types of land use (Commercial; and Office, Office/Warehouse, Mixed Use) are listed in the second row of Table 4.5. The detailed projections for individual parcels are listed in Table 7.1.3 and Table 7.1.4 in Appendix 1. The total land value projected for all the vacant parcels is estimated to be $86.94 million based on the assumption that all parcels will be in conformance with the land use plan by 2010, and the new freeway interchange will be in place by then.

The estimated land values of the vacant parcels are calculated based on the assumption that there would not be any change in the current land use that would influence the land values, and the land values would grow @ 3% annually. The estimated land values have two components:

- Current Land Value: It is calculated by adding up the land values of these parcels as of 2001 figures received form the county GIS data. The current land values of all the vacant parcels are added to account for about $20.68 million.
- Growth from 2001 to 2010: There will be growth in land values of these parcels from 2001 to 2010. The growth in land values is calculated for $20.68 million @ 3% per year for nine years, or $6.30 million.

The total estimated land values of the vacant parcels are calculated by adding current land values and the growth in land value for nine years, and estimated to be about $26.99 million by the end of 2010.

Table 4.5: Land Value Projections for Vacant Parcels by 2010 – I

	Commercial	Office, Office/Warehouse, Mixed Use	Total
Number of Parcels	9	44	53
Projected Land Value	20,663,822.83 Note: The Land Value is projected using Eq-4.1	66,275,365.78 Note: The Land Value is projected using Eq-4.2	86,939,188.61
Estimated Land Value by the end of 2010			
Current Land Value	8,921,289.60	11,760,632.00	20,681,921.60
Growth 2001 to 2010 @ 3% per year	2,718,969.84	3,584,325.26	6,303,295.09
Estimated Land Value	11,640,259.44	15,344,957.25	26,985,216.69
Total Increase	**9,023,563.39**	**50,930,408.53**	**59,953,971.92**

Note: All the figures are in constant 2001 dollars.
Please refer to the Table 7.1.3 and Table 7.1.4 in Appendix 1 for details.

Source: Author

The total increase in the land value is then calculated by subtracting the estimated land value ($26.99 million) from the projected land values ($86.94 million) of the vacant parcels, or $59.95 million. **Hence, the land value of all the vacant parcels is estimated to increase by $59.95 million by 2010 if the proposed interchange is constructed by 2010 and the use of each of the parcels is changed to reflect the township's land use plan.**

This is a dramatic increase in the land value, largely due to the fact that the current land use of the vacant parcels are either agriculture or open space. Therefore, their current land value is much less compared to what it would have been if categorized as specified in the proposed land use plan. So the amount of $59.96 million does not only reflect the increase in land values of vacant parcels as a result of new interchange but also associated with change in land use. A major portion of total increase ($59.95 million) is attributed to the change in land use while a small portion of it is attributed to new interchange.

Another step in the analysis was completed to determine the proportions attributable to change in land use and the new interchange respectively, out of the total increase of $59.95 million in land value of vacant parcels. The amount attributed to the change in land use was calculated in the same manner as was done for the projected land value, the only difference was that the variables associated with "distance from highway interchange" were calculated under existing conditions, without considering the new interchange. The total land value associated with the change in land use was calculated to be $77.10 million and tabulated in the third row of Table 4.6. The amount $77.10 million reflects the total land value of vacant parcels by 2010 under assumption that actual land use changes will occur by 2010 without a new freeway interchange. The assumption of adopting the proposed land use plan without new interchange is somehow unrealistic because the proposed land use plan has been built keeping in mind that the new highway interchange will be constructed at the time of adoption of the proposed land use plan.

The fourth row of Table 4.6 shows the increase in land value of vacant parcel attributed to the new interchange. It is calculated by deducting the projected land value (without interchange but adopted land use plan) from projected land value (with interchange and adopted land use plan). **Hence, the land value of all the vacant parcels will be $9.84**

million high by 2010 as a result of the new interchange. The increase in land value attributed to the change in land use is estimated to be $50.11 million ($59.95million - $9.48 million).

Table 4.6: Land Value Projections for Vacant Parcels by 2010 – II

	Commercial	Office, Office/Warehouse, Mixed Use	Total
Number of Parcels	9	44	53
Projections using Regression Models:			
With Proposed Interchange	20,663,822.83	66,275,365.78	86,939,188.61
Without Proposed Interchange but with adopted Land Use Plan	20,077,055.90	57,018,465.59	77,095,521.48
	586,766.93	**9,256,900.19**	**9,843,667.12**
Estimated land value based on current value and without adopting land use plan	11,640,259.44	15,344,957.25	26,985,216.69
	9,023,563.39	**50,930,408.53**	**59,953,971.92**

Note: All the figures are in constant 2001 dollars.
Please refer to the Table 7.1.3 and Table 7.1.4 in Appendix 1 for details.

Source: Author

The assumption about changing the vacant parcel's land use without the new interchange may be unrealistic. Therefore, the actual increase in land value for the vacant parcels attributed to the new interchange may be more than $9.84 million and actual increase in land value attributed to change in land use may be less than $50.11 million.

4.2 Cost Analysis

The total interchange cost has four components, land acquisition, site clearance, relocation, and interchange construction. The Community Development Department of Deerfield Township hired a private consultant, Pflum, Klausmeier and Gehrum Consultants (PKG), to prepare seven different options for the proposed interchange plan. According to the township officials, none of the options are realistic for several reasons. For the purpose this analysis the one option that was deemed most practical from township officials' perspective was selected as shown in Figure 4.3. This design was used in the study, but the location was moved to the Irwin Simpson Road.

Figure 4.3: Proposed Design of New Interchange

Source: Community Development Department of Deerfield Township

4.2.1 Land Acquisition/ Site Clearance/ Relocation:

The interchange construction at Irwin-Simpson Road will require the road width and ROW to be expanded to meet the standards of interchange construction. As shown in Figure 4.4, the existing road width and ROW of Irwin Simpson on the west side of I-71 currently meets the criteria, but these are not met on the east side of I-71. Irwin Simpson continues on the east side of the I-71 through a residential zone of Deerfield Township and then connects to Columbia Road. The township would be required to acquire the properties along the Irwin Simpson Road between I-71 and Columbia Road to widen the road and meet the ROW criterion. Also the township has proposed a 70' green buffer on the both sides of the road.

Figure 4.4 shows the identified properties that need to be acquired for the purpose of interchange construction. The total cost associated with the interchange construction includes land acquisition, site clearance and relocation cost but in term of immediate return the township will receive a 70' green buffer on either side of Irwin Simpson Road between I-71 and Columbia Road. There is a part of cost that is associated with land used for the green buffer and is not a part of interchange cost. After discussion with township officials about allocating the cost associated with interchange and the green buffer, it is assumed that the land acquisition cost is attributed to interchange construction and the site clearance and relocation cost is attributed to the green buffer zone.

The land acquisition for the identified properties in Figure 4.4 is calculated based on the Warren County 2001 GIS information and estimated to be about $6.76 million. Table 4.7

shows the calculations related with total land acquisition cost if the properties are acquired in 2006. Property values are expected to grow @ 3% per year from 2001 until 2006. This growth rate does not reflect the inflation but the growth in land value as a result of general increase in demand because of population growth. The total land acquisition cost is estimated to be $7.83 million

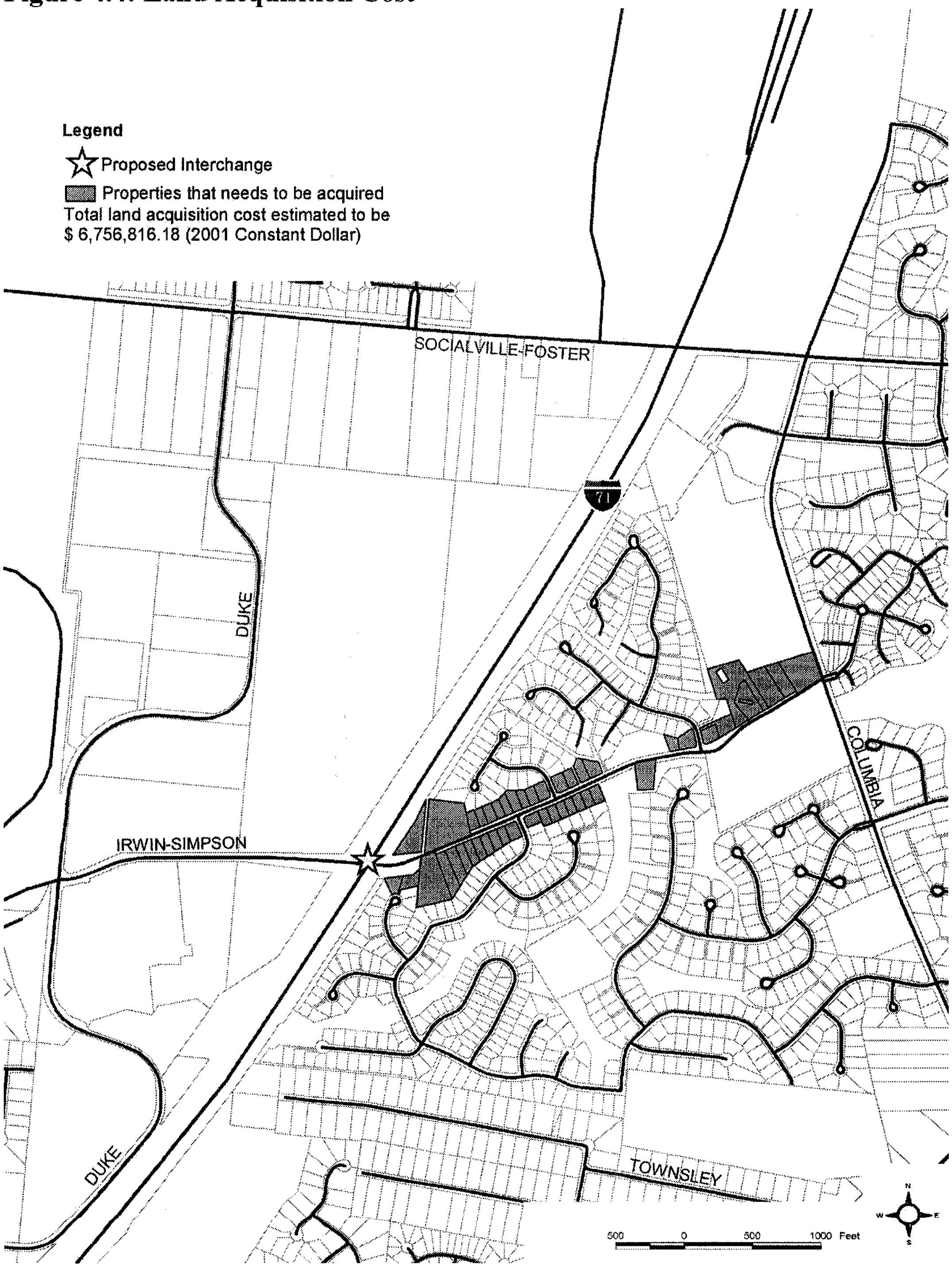
Table 4.7: Land Acquisition Cost

Current Property Value	6,756,816.18
Growth @3% per year from 2001 to 2006	1,076,185.64
Total Land Acquition Cost	**7,833,001.82**

Note: All the figures are in constant 2001 Dollars.

Source: Author

Figure 4.4: Land Acquisition Cost



Source: Warren County GIS Department and Deerfield Township Community Development Department

4.2.2 Interchange Construction Cost

Estimates for the interchange construction costs were collected from experts working in the field and township officials. The interchange construction cost is expected to be between $15 to $25 million. Both upper and lower limits of the construction cost are included in this analysis.

The total interchange cost is computed by adding the land acquisition cost and the expected interchange construction cost. Table 4.8 shows the estimated maximum and minimum estimates of the total interchange cost, which are $22.83 million and $32.83 million respectively.

Table 4.8: Total Interchange Cost

	Min. Range	Max. Range
Interchange Construction Cost	15,000,000.00	25,000,000.00
Land Acquisition	7,833,001.82	7,833,001.82
Total Interchange Cost	**22,833,001.82**	**32,833,001.82**

Note: All the figures are in constant 2001 Dollars.

Source: Author

4.3 Comparison of Land Value and Interchange Cost

The forecasted increase in land value and the estimated interchange cost is tabulated in Table 4.9. The increase in land value attributed to the new interchange is estimated to be $9.84 while the total increase in land value is estimated to be $59.95 million. The increase in land value attributed to the new interchange is calculated based on assumption that the proposed land use plan will be adopted without the new interchange while the total increase in land value is calculated assuming that the change in land use will occur by 2010 as well as the completion of construction of new interchange. The ranges of estimated interchange costs are calculated to be $22.83 million and $32.83 million.

Table 4.9: Comparison of Increase in Land Value and Estimated Interchange Cost

Increase in Land Value (From Table 4.6)		Estimated Interchange Cost (From Table 4.8)	
[1]New Interchnage	[2]Total	Minimum	Maximum
9,843,667.12	59,953,971.92	22,833,001.82	32,833,001.82

[1] It is the amount attributed to new interchange

[2] It is the total increase in land value as a result of new interchange and adopted land use plan.

Note: All the figures are in constant 2001 dollars.

Source: Author

The increase in land value attributed to the new interchange is almost half of the minimum estimated interchange cost while the total increase in land value is almost twice than that of maximum interchange cost. It is understood that the amount (increase in land value) attributed to new interchange assumes change in land use without the new interchange, which may be unrealistic since the proposed land use plan has been prepared assuming the new interchange. Therefore, it may be quite appropriate to compare the total increase in land value, $59.95 million, with the estimated interchange cost. It is apparent from the final results that the total increase in property value will outweigh the estimated interchange cost in future.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

The land value of the study area is estimated to increase by $59.95 million by 2010 if the proposed interchange is constructed by 2010 and the use of each of the parcels is changed to reflect the township's land use plan. This is a significant increase in land value and is surprising. If we look back to the regression models we find that the coefficients of the variable related to distance from interchange are not so high to expect such a drastic increase in land value of the vacant parcels. In fact, the reason for such a large increase is that the current land use of these vacant parcels are either agriculture or open space. Hence, their current land value is small compared to what it would have been if zoned under the proposed land use plan.

The total estimated increase of $59.95 million not only reflects the increase in the land value as a result of the new interchange but also increases associated with the change in land use. Out of the total increase of $59.95 million, the land value is estimated to increase by $9.84 million as a result of new interchange and $50.11 million as a result of the change in land use. These figures are calculated based on the assumption that the new land use plan would be adopted without the new interchange, which is unrealistic because the new land use plan has been designed considering the new interchange. Hence, the actual increase in land value for the vacant parcels attributed to the new interchange may be more than $9.84 million and actual increase in land value attributed to change in land use may be less than $50.11 million.

In considering the results of this research, it is important to recognize that there are numerous types of benefits and costs associated with interchange construction and uses. For instance, a decrease in travel time, an increase in value of currently developed properties, a decrease in value of residential property due to an increase in traffic, elevated pollution levels, etc. The analysis performed here concentrated only on comparing the increase in land value of currently vacant parcels with the associated interchange costs. The properties' value and revenue will increase dramatically if the new interchange is built and changes in land use occur.

The results presented here are based on assumptions that the construction of the proposed interchange will be completed along with land use changes made by 2010. Further, it is also assumed that there will not be any new road construction or other infrastructure developments that influences the property value in Deerfield Township. In reality, the new interchange may bring a plethora of new development projects to Deerfield Township, such as construction of new roads, widening of existing roads, and further land subdivision.

The assumption that land use in the study area will change to reflect the township's proposed land use plan without new interchange is unrealistic because the proposed land use plan assumes that a new highway interchange will be constructed. In other words, it is not rational to split the increase in land value of vacant parcels for "new interchange" and "change in land use" simply because they are interdependent. Therefore, it's appropriate to compare more than the $9.84 million increase in land value of vacant parcels with estimated interchange costs. The total interchange cost has been estimated to vary between $22.83 million to $32.83 million. Hence, it's concluded that the total increase in land value is about two times that of maximum interchange cost and three times that of minimum interchange cost, while the increase in land value attributed to new interchange is almost half of the minimum estimated interchange cost.

The results of both the models developed as a part of this analysis reveal that there is a high correlation between the land value of any parcel, of any land use, to "corner lot" and "lot shape." The "corner lot" is the most significant variable found in both the models. The commercial land values are also associated with the "distance to nearest interchange" and "adjacency to CBD" variables, while the land value for office, office/warehouse and mixed-use properties are associated with "distance to second nearest interchange."

Below are certain recommendations for the planners and officials of Deerfield Township deduced from the present analysis and results. These recommendations are specifically drawn from the regression models that are developed for the two sets of land uses (commercial; and office, office/warehouse, and mixed-use).

1. Township officials should carefully consider how the land is subdivided and new roads are constructed, as they are the most important factors for determining the land value for all types of land uses.

   "Corner lot" was found to be most significant in both regression models, showing that the property values increase more rapidly with the enhanced

access and visibility by corner locations. This warrants further analysis to understand how the benefits of a corner lots can be achieved through better design and development practices

2. Policies should be developed to discourage any subdivision, which would result in frontage/depth ratio less than 0.25.

   "Lot shape" was found to be significant in both regression models. Frontage/depth ratio has been used as a proxy for "lot shape," so the land value of any parcel can be expected to be lower if the frontage/depth ratio is less than 0.25. A parcel having lower frontage/depth ratio has constraints in terms of use of land. Limited design options are possible for a parcel, which is narrow and deep (high frontage/depth ratio).

3. Planners and township official should use land use and development regulation to bring the commercial facilities in close proximity to the freeway interchange and CBD area. Other properties such as office, office/warehouse, and mixed-use development should be developed in the area centered between the two nearest interchanges in Deerfield Township.

   "Distance to nearest interchange" was found to be significant for commercial properties. This means that the land value of commercial properties will be high if they are located near the nearest interchange. On the other hand, "distance from second nearest interchange" was found to be significant for office, office/warehouse, and mixed-use properties. This means that the land value of these (office, office/warehouse, and mixed-use) properties will be high if they are located in the middle of two

nearest interchanges so that the distance to the second nearest interchange can be minimized. This result provides insight that commercial properties are more prone to access than office, office/warehouse, and mixed use because commercial properties require access for its customers. Other uses of property (office, office/warehouse, and mixed use) do not include customers rather it's only the staffs working there.

4. A new retail business district should be developed near the proposed interchange, and nearby parcels should be zoned for commercial use. Expanding the existing CBD will help to increase the property values, but not as efficiently as a new retail business district, near the new interchange, would.

This study offers an example of the quantitative analysis that might be conducted for projects considering the impact of infrastructure changes on land values. Nevertheless, these quantitative approaches have their limits and advantages. The most important factors concerning the idea of "quality of life" are not well addressed by quantitative approaches because the difficulty in using qualitative measures for qualitative factors. The analyses in the study do not include parameters that directly measure the qualitative aspects of the project. Researchers are yet to find an optional way to quantify them. Anderson and Wassmer (2000) made an attempt to quantify the qualitative aspects of economic development policies by conducting a survey the individual's degree of satisfaction with the adopted economic development policies in the metropolitan Detroit region. However, these researchers recognized that these survey results must be used with caution because of difficulties in comparing or standardizing the degree of satisfaction across individuals.

5.1 Further Research

Two directions for further research are recommended:

- First, devising a method to quantify the qualitative aspects of similar projects. A method to standardize qualitative aspects and compare the degree of satisfaction across individuals would facilitate including these important issues into the decision-making process.
- Second, conduct a fiscal impact analysis to measure the increase in property taxes for Deerfield Township, as well as the additional costs of proving township services.

It is important to review the literature about the qualitative aspects rather than making decisions based only on the impressive results of quantitative analyses. The bottom line is to maximize the general public welfare, while preserving community values.

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APPENDIX

Appendix 1: Tables

Table 7.1.1: Input Data for Regression Modeling for Commercial properties

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
1667507.034	1	0.6020613	2	2	2	0	8568.520	10183.740	4180.000	4759.97	3655.190	0
662809.060	1	5.2359304	2	2	2	0	5840.300	7148.760	160.000	2387.81	696.500	1
495314.147	1	7.0064890	1	2	2	0	5156.890	6508.370	80.000	1505.23	2076.570	2
113864.091	1	0.6199401	1	1	2	0	5370.800	6767.200	95.000	1779.38	2467.760	2
865182.148	1	0.4247354	1	2	2	0	5558.490	6378.833	25.000	4759.97	2603.990	2
310385.161	1	0.3632906	1	2	0	0	6490.460	7303.700	160.000	1786.10	2723.700	2
50399.263	1	0.5349285	1	2	0	0	6520.910	6869.780	150.000	1520.34	2399.350	2
680636.700	1	0.4247354	1	2	2	0	5462.413	5572.480	167.061	1202.14	2291.590	2
318319.708	1	0.3444336	1	2	0	0	7782.550	7893.400	263.606	2810.82	3006.240	2
43514.937	0	21.6224604	2	2	2	2	924.218	26921.488	7614.154	5587.96	11668.186	2
190857.510	0	1.0982539	0	1	2	1	4212.748	22664.717	3357.383	2447.92	7411.415	1
608182.400	0	1.1769495	2	2	2	1	3244.559	23750.284	4442.950	3533.49	8496.982	2
109143.582	0	0.2796317	0	2	2	1	3165.665	22858.670	3551.336	2700.78	7605.369	1
51722.175	0	0.1146510	0	2	2	1	2967.261	23447.060	4139.726	3289.17	8193.758	2
57508.317	0	0.1145921	0	2	2	1	2899.354	23458.903	4151.569	3301.02	8205.601	2
790686.030	0	1.8355959	0	1	2	1	3257.848	23862.573	4555.239	3645.78	8609.271	2
252424.216	0	6.8753309	1	1	2	2	4262.605	30259.877	10952.543	2902.51	15006.574	2

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
490545.702	0	4.7663449	1	1	0	1	4386.128	30383.399	11076.065	2126.05	15130.097	2
54687.222	0	11.7082195	1	2	2	1	2382.698	23641.637	4334.303	3483.75	8388.336	2
90877.415	0	11.6909135	2	2	2	1	2100.048	23924.287	4616.953	3766.40	8670.986	2
107030.408	0	6.8728132	1	2	2	2	4496.504	30493.775	11186.441	3136.41	15240.473	2
52174.424	0	1.8351904	0	2	2	1	1968.322	24079.974	4772.640	3863.18	8826.673	2
198953.871	0	5.9735455	0	1	0	0	2937.609	25276.000	5968.666	5118.11	10022.699	2
186257.802	0	3.0949039	1	2	0	0	2622.399	24960.790	5653.456	4802.90	9707.489	2
99920.411	0	12.0028530	2	2	2	2	2074.127	24412.518	5105.184	4254.63	9159.217	2
143839.175	0	6.9473424	1	2	2	2	4389.236	30386.506	11079.172	3470.81	15133.203	2
196900.187	0	6.8760727	2	2	1	2	4586.842	30584.112	11276.778	3273.20	15330.810	2
58301.220	0	1.8361537	0	2	2	1	1714.221	24334.076	5026.742	4117.28	9080.773	2
381342.576	0	3.6101660	2	1	2	2	1690.504	25857.949	6550.615	5641.15	10604.646	2
169749.387	0	1.1465137	0	2	1	0	2694.661	26835.072	7527.738	6677.19	11581.771	2
207185.894	0	3.4534204	1	2	1	1	2373.801	26514.212	7206.878	6356.33	11260.911	2
167402.572	0	0.7462251	1	0	0	1	6264.802	32262.073	12954.739	2832.57	18495.623	2
184027.034	0	3.4331912	1	2	2	2	1430.092	24594.243	5286.909	4436.36	9340.942	2
20701.108	0	11.9684415	1	2	2	2	1597.823	24426.512	5119.178	4268.63	9173.211	2
467001.560	0	0.7443658	1	0	0	1	5831.382	31828.652	12521.318	1590.36	16575.350	2
226181.993	0	6.8718998	1	1	1	2	3299.008	29296.279	9988.945	3213.17	14042.977	2
565928.931	0	6.1311585	1	2	1	1	6512.176	32509.446	13202.112	1961.62	14832.650	1

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
113421.158	0	6.7818034	1	2	2	2	3804.482	29801.752	10494.418	4055.56	14548.449	2
114126.745	0	6.9081091	1	2	1	2	4238.755	30236.025	10928.691	3621.29	14982.723	2
27288.041	0	11.8762648	1	2	2	2	1358.905	24665.430	5358.096	4507.54	9412.129	2
125158.154	0	6.8893634	1	2	2	2	3509.650	29506.921	10199.587	4350.40	14253.618	2
47785.377	0	7.9415508	1	2	1	1	1385.164	25525.576	6218.242	5367.69	10272.275	2
35663.741	0	11.8276992	2	2	2	2	1138.143	24886.191	5578.857	4728.31	9632.891	2
92696.534	0	6.8254979	1	2	1	2	3072.043	29069.314	9761.980	3440.13	13816.012	2
219393.567	0	6.1146278	1	1	1	1	4131.090	30128.361	10821.027	2381.09	14875.059	2
524372.603	0	1.2574646	0	2	1	1	2431.782	26572.193	7264.859	6414.31	11318.893	2
230925.763	0	6.8775349	2	2	1	2	3601.452	29598.723	10291.389	4258.59	14345.420	2
36603.166	0	1.2668303	0	0	1	1	2091.042	26231.454	6924.120	6073.57	10978.153	2
122555.842	0	5.9839661	1	1	2	2	1198.016	27195.287	7887.953	6657.94	11941.984	2
48869.106	0	12.0116787	2	2	1	2	1274.702	25415.113	6107.779	5257.23	10161.813	2
81296.874	0	11.9619606	2	2	2	2	1627.370	25767.782	6460.448	5609.90	10514.481	2
76538.230	0	1.2341545	1	0	1	1	1612.722	25955.744	6648.410	5797.86	10702.443	2
545810.275	0	0.7364464	1	0	1	1	3056.230	33645.947	14338.613	3407.66	18392.646	2
87886.178	0	11.9845922	1	2	2	2	1657.015	25911.451	6604.117	5753.56	10658.150	2
343390.895	0	8.0143360	2	2	2	2	2368.731	28366.001	9058.667	4170.92	13112.698	2
248788.789	0	8.0202569	2	2	2	2	2216.834	28214.105	8906.771	4295.34	12960.802	2
95835.125	0	11.9848542	2	2	2	2	1444.125	26124.340	6817.006	5966.45	10871.040	2

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
248742.937	0	7.9879655	1	2	2	2	1151.021	27148.292	7840.958	5361.15	11894.988	2
65554.907	0	11.9606607	2	2	2	2	1898.557	27573.720	8266.386	7415.83	12320.419	2
65181.601	0	12.0291614	1	2	2	2	1299.283	26974.445	7667.111	6816.56	11721.146	2
56666.387	0	11.9935298	2	2	2	2	1111.780	26456.685	7149.351	6298.80	11203.385	2
48528.821	0	11.9852489	2	2	2	2	1132.754	26435.711	7128.377	6277.83	11182.411	2
82226.813	0	11.9766286	2	2	2	2	734.850	26732.121	7424.787	6194.77	11478.818	2
43350.046	0	12.0219019	2	2	2	2	2072.877	28070.147	8762.813	4466.77	12816.845	2
24221.690	0	0.1032133	2	0	2	2	1983.191	27980.461	8673.127	4528.99	12727.158	2

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

Table 7.1.2: Input Data for Regression Modeling for Office, Office/Warehouse, Mixed Use

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/ Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
662025.152	0	3.6617340	0	1	1	1	2247.910	11787.320	5350.090	3324.070	4578.230	1
197462.443	0	1.7943665	1	1	2	1	2991.920	12383.500	2966.970	1463.130	5118.580	1
355093.844	0	1.1080170	0	0	1	1	836.250	10489.590	7573.130	6590.160	5513.910	1
63998.001	0	1.3762930	1	1	1	1	1155.000	10617.650	7676.320	7590.160	5602.550	1
180772.600	0	1.6123019	1	1	2	1	6740.210	18863.850	1098.330	200.000	8258.650	1
126489.372	0	1.7272597	1	1	2	1	7246.890	19764.660	737.740	882.890	8258.650	1
57415.619	0	1.7399447	1	1	2	0	9004.250	14689.050	2235.330	855.290	9869.130	1
25865.484	0	1.9191599	1	1	1	0	9104.250	14689.050	2410.890	721.210	9869.130	2
38273.032	0	1.5365911	1	1	1	0	9204.250	14689.050	2549.850	602.180	9869.130	2
886472.908	0	2.4846332	2	1	2	1	9591.960	22861.590	3536.990	2882.330	2081.770	0
52066.217	0	2.7749279	2	1	1	1	9905.960	23106.420	3848.690	3248.300	2355.870	1
233690.247	0	2.0263148	1	1	1	1	8225.310	23956.590	4610.210	4014.640	3119.680	2
995172.537	0	2.2195347	1	1	2	1	7328.670	23658.410	5780.310	5178.970	4717.770	2
357153.220	0	3.4430601	2	2	2	2	4411.570	21673.050	2557.040	2227.220	4638.580	1
281388.881	0	2.7399803	1	2	1	2	4962.190	22848.290	3735.740	3356.020	5768.870	1
341138.379	0	1.0671916	0	2	1	2	5398.750	23342.070	4264.060	3844.830	6279.340	1

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/ Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
25150.745	0	2.4202066	2	1	1	0	13030.000	12922.970	2540.630	3981.130	6544.760	1
292351.291	0	3.4410999	2	2	2	2	4311.790	21738.370	2654.160	2305.770	4638.580	2
441737.940	0	1.0694802	0	1	1	2	4233.411	23990.920	4897.180	4592.820	6840.840	1
16084.497	0	5.9019564	2	2	1	0	13030.000	12922.970	2540.630	3981.130	6544.760	1
36890.382	0	3.9514364	2	1	1	0	13030.000	12922.970	2540.630	3981.130	6544.760	1
21785.950	0	7.7214902	2	2	1	0	11600.000	13186.870	2916.830	4268.640	6784.590	1
27518.186	0	2.4928969	2	2	1	0	13030.000	12922.970	2771.390	3981.130	6544.760	1
8063.293	0	5.7296690	2	1	1	0	13030.000	12922.970	4497.090	3981.130	6544.760	1
240438.099	0	2.7497306	1	2	1	2	4180.743	23020.690	3962.580	3553.980	6000.820	2
30920.072	0	1.3528429	1	1	1	1	6148.920	25675.830	6415.510	5316.790	4979.190	1
221073.132	0	1.5244277	2	1	1	1	5932.430	24447.360	5323.640	4958.110	5462.070	2
201497.942	0	2.7133280	2	1	2	2	4873.640	23469.940	4400.230	4024.280	6417.090	1
329360.422	0	2.7598944	1	2	1	2	5283.090	23975.490	4927.200	4601.340	6275.200	2
291183.196	0	2.7570272	1	1	2	2	4719.620	24462.810	5534.390	5101.170	7640.640	2
199421.162	0	2.7415847	2	1	2	2	4082.076	24193.880	5092.820	4846.930	7198.850	1
368396.129	0	0.3244062	0	1	1	1	3236.690	24461.350	5485.190	5085.000	7328.060	2
118455.022	0	3.3585744	1	1	1	1	6568.730	18893.820	10507.500	150.000	8943.140	0
680317.211	0	0.2803692	0	1	1	1	2960.990	23942.070	4782.270	4515.610	6878.010	1

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/ Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
76248.115	0	2.7573141	1	1	2	2	4171.520	24237.230	5120.190	4743.430	7185.040	2
214682.827	0	2.7068304	2	1	2	2	4437.110	24433.600	5252.400	4904.020	7300.590	1
513977.275	0	1.1094654	1	1	1	2	3214.970	26793.720	7743.310	7454.860	9812.830	0
3479870.829	1	0.2892033	2	1	1	1	2429.790	14983.540	2607.660	_	_	_
812018.353	1	0.2511889	2	1	1	1	8515.160	15030.498	_	_	_	_
1781381.519	1	0.2905788	1	1	1	0	11202.810	12456.336	_	_	_	_
125003.277	1	0.2869617	1	2	1	1	8273.420	9588.570	_	_	_	_
520974.751	1	1.5900836	1	1	1	1	8244.790	9451.970	_	_	_	_
436338.139	1	0.2869605	1	2	1	1	8127.520	8686.530	_	_	_	_
131618.003	1	0.2869656	0	2	1	1	8015.630	9451.970	_	_	_	_
415890.917	1	0.2869576	2	2	1	1	7212.209	7709.570	_	_	_	_
336020.723	1	2.0661187	1	2	1	1	5014.500	10897.300	_	_	_	_
681542.959	1	2.0661187	1	1	2	1	4581.700	8244.780	_	_	_	_
115573.653	1	0.4729452	0	1	0	0	11410.000	12000.000	_	_	_	_
216153.681	1	0.3469754	0	1	1	0	11553.510	12886.941	_	_	_	_
676587.952	1	5.1293996	2	2	2	1	6047.630	7869.292	_	_	_	_
734475.930	1	0.0653527	1	1	1	1	7724.860	8245.290	_	_	_	_
175948.511	1	0.3611284	2	2	1	1	7048.370	7605.240	_	_	_	_

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/ Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
50512.222	1	0.5341282	0	2	1	1	8013.680	8428.890	_	_	_	_
895529.408	1	0.3461416	1	2	1	1	6288.340	8964.120	_	_	_	_
243315.461	1	3.4428967	2	2	2	1	4033.850	8507.930	_	_	_	_
936343.560	1	1.2692563	1	2	1	1	4465.290	11468.540	_	_	_	_
334177.839	1	0.5100877	1	0	1	1	4303.880	10019.890	_	_	_	_
56160.595	1	0.3561216	1	0	1	1	3949.730	10019.890	_	_	_	_
433222.757	1	2.2068785	2	1	1	1	1071.320	17668.092	_	_	_	_
402499.206	1	2.2076565	2	1	1	1	504.350	14963.281	_	_	_	_
234688.544	1	0.2969894	2	2	1	0	8739.430	12195.380	_	_	_	_
232776.969	1	0.2995142	1	2	1	0	8507.780	11958.230	_	_	_	_
233265.995	1	0.2988005	1	2	1	0	8269.750	11758.370	_	_	_	_
233913.445	1	0.2979735	2	2	1	0	8051.490	11543.890	_	_	_	_
87546.418	1	0.4911680	2	2	1	0	7748.900	10472.400	_	_	_	_
270784.262	1	0.2865750	1	2	1	0	7754.910	10969.190	_	_	_	_
120216.882	1	0.0274504	2	0	1	0	6903.980	11434.670	_	_	_	_
60299.917	1	0.0280266	2	0	1	0	6882.020	11251.530	_	_	_	_
270724.838	1	0.2867857	1	2	1	0	8009.530	10704.730	_	_	_	_
218203.603	1	0.3043488	1	2	1	0	8233.420	10430.990	_	_	_	_

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

		Variables										
		Dependent Variable	Independent Variable									
Area(Sqft)	Study Area	Land Value/ Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	Distance to Nearest Highway Interchange	Distance to Second Nearest Highway Interchange	Distance to Nearest Church	Distance to Nearest School	Distance to Nearest Park/ Recreational Facility	Adj Land Use
464780.235	1	0.2539910	1	2	1	0	8577.830	10180.590	_	_	_	_
290987.024	1	0.2802530	1	2	1	0	8915.340	9808.700	_	_	_	_
115179.206	1	0.3902614	1	0	1	0	9089.540	9581.250	_	_	_	_
102595.430	1	0.2413363	1	0	1	0	9188.590	9493.020	_	_	_	_
217980.449	1	0.4129728	1	2	1	0	9326.330	9374.610	_	_	_	_
222008.454	1	0.2409368	1	1	1	0	9205.430	9519.450	_	_	_	_
37169.025	1	0.7734935	1	2	1	0	8718.370	9594.600	_	_	_	_
217560.062	1	0.4136789	1	2	1	1	8615.610	9862.600	_	_	_	_
198003.080	1	0.4129734	2	1	1	1	8447.330	10269.000	_	_	_	_
85842.195	1	0.2385773	2	2	1	0	6730.480	11687.480	_	_	_	_
267725.918	1	0.3125958	2	1	1	1	8744.850	9006.170	_	_	_	_

NOTE: All the eleven variables (one dependent and ten independent variables) are calculated in GIS, mostly using Network Analysis.
Source: Author

Table 7.1.3: Land Value Projections for Commercial Properties

	Variables							Land Values				
	Dependent Variable	Significant Independent Variable						Current	Projections			
									Projection-1		Projection-2	
Area(Sqft)	Land Value/Sqft	Corner Lot	Lot Shape	Adj to Road	Adj to CBD	[1]Distance to Nearest Highway Interchange	[2]Distance to Nearest Highway Interchange	Current Land Value	Projected Land Value/ Sqft	[3]Projected Land Value	Projected Land Value/ Sqft	[4]Projected Land Value
1667507.034	0.6020613	2	2	2	0	8568.520	10183.740	1,003,941.45	5.05452	8,428,442.08	4.95077	8,255,449.47
662809.060	5.2359304	2	2	2	0	5840.300	7148.760	3,470,422.11	5.35966	3,552,430.08	5.18411	3,436,074.92
495314.147	7.0064890	1	2	2	0	5156.890	6508.370	3,470,413.12	3.25906	1,614,260.24	3.03359	1,502,579.04
113864.091	0.6199401	1	1	2	0	5370.800	6767.200	70,588.92	1.08824	123,910.92	0.87313	99,417.63
865182.148	0.4247354	1	2	2	0	5558.490	6378.833	367,473.49	3.18065	2,751,838.25	3.05105	2,639,715.75
310385.161	0.3632906	1	2	0	0	6490.460	7303.700	112,760.01	3.03606	942,347.35	2.93994	912,513.86
50399.263	0.5349285	1	2	0	0	6520.910	6869.780	26,960.00	3.03203	152,812.13	2.98835	150,610.39
680636.700	0.4247354	1	2	2	0	5462.413	5572.480	289,090.50	3.19836	2,176,919.19	3.17802	2,163,078.22
318319.708	0.3444336	1	2	0	0	7782.550	7893.400	109,640.00	2.89289	920,862.59	2.88269	917,616.60
								8,921,289.60		**20,663,822.83**		**20,077,055.90**

[1] It is calculated under the assumption that new highway interchange is in place

[2] It is calculated under existing conditions

[3] Land value is projected under the assumption that the construction of proposed interchange will finish by 2010 and also the proposed land use plan will be adopted by 2010.

[4] Land value projected under the assumption that there will not be any interchange constructed by 2010 but the proposed land use plan will be adopted by 2010.

Note: All the figures are in 2001 Constant Dollar.
Source: Author.

Table 7.1.4: Land Value Projection for Office, Office/Warehouse, and Mixed Use

	Variables					Land Values				
	Dependent Variable	Significant Independent Variables				Current	Projections			
							Projection-1		Projection-2	
Area (Sqft)	Land Value/Sqft	Corner Lot	Lot Shape	[1]Distance to Second Nearest Interchange	[2]Distance to Second Nearest Interchange	Current Land Value	Projected Land Value/Sqft	[3]Projected Land Value	Projected Land Value/Sqft	[4]Projected Land Value
120,216.88	0.0274504	2	0	11,434.670	14,964.900	3,300.00	2.79791	336,355.76	2.45498	295,129.83
37,169.03	0.7734935	1	2	9,594.600	17,096.250	28,750.00	4.09866	152,343.21	3.37020	125,267.20
50,512.22	0.5341282	0	2	8,428.890	21,538.770	26,980.00	3.23214	163,262.53	1.95914	98,960.28
56,160.60	0.3561216	1	0	10,019.890	23,111.000	20,000.00	1.95557	109,825.91	0.68429	38,430.24
60,299.92	0.0280266	2	0	11,251.530	15,092.020	1,690.00	2.81569	169,785.81	2.44263	147,290.68
85,842.20	0.2385773	2	2	11,687.480	15,207.260	20,480.00	4.87516	418,494.66	4.53333	389,150.57
87,546.42	0.4911680	2	2	10,472.400	15,207.260	43,000.00	4.99313	437,131.06	4.53333	396,876.37
102,595.43	0.2413363	1	0	9,493.020	16,744.390	24,760.00	2.00672	205,880.58	1.30249	133,629.49
115,179.21	0.3902614	1	0	9,581.250	16,657.390	44,950.00	1.99816	230,146.07	1.31094	150,992.73
115,573.65	0.4729452	0	1	12,000.000	15,408.980	54,660.00	1.83452	212,022.18	1.50340	173,753.20
125,003.28	0.2869617	1	2	9,588.570	19,317.970	35,871.15	4.09925	512,419.15	3.15448	394,319.73
131,618.00	0.2869656	0	2	9,451.970	19,198.690	37,769.84	3.13281	412,333.96	2.18636	287,763.97
175,948.51	0.3611284	2	2	7,605.240	20,738.770	63,540.00	5.27151	927,513.85	3.99622	703,128.16
198,003.08	0.4129734	2	1	10,269.000	17,607.630	81,770.01	3.96198	784,484.80	3.24931	643,373.22
216,153.68	0.3469754	0	1	12,886.941	16,702.780	75,000.01	1.74841	377,924.59	1.37777	297,810.07
217,560.06	0.4136789	1	2	9,862.600	17,607.630	90,000.01	4.07264	886,043.85	3.32055	722,418.87
217,980.45	0.4129728	1	2	9,374.610	16,888.370	90,020.00	4.12002	898,083.62	3.39039	739,038.58
218,203.60	0.3043488	1	2	10,430.990	15,854.380	66,410.00	4.01746	876,623.20	3.49079	761,702.89
222,008.45	0.2409368	1	1	9,519.450	17,096.250	53,490.01	3.05506	678,248.39	2.31926	514,896.24
232,776.97	0.2995142	1	2	11,958.230	14,400.920	69,720.01	3.86918	900,654.93	3.63192	845,427.48

Note: All the figures are in 2001 Constant dollar.
Source: Author.

	Variables					Land Values				
	Dependent Variable	Significant Independent Variables				Current	Projections			
							Projection-1		Projection-2	
Area (Sqft)	Land Value/Sqft	Corner Lot	Lot Shape	Distance to Second Nearest Interchange [1]	Distance to Second Nearest Interchange [2]	Current Land Value	Projected Land Value/Sqft	Projected Land Value [3]	Projected Land Value/Sqft	Projected Land Value [4]
233,266.00	0.2988005	1	2	11,758.370	14,610.920	69,700.00	3.88858	907,073.45	3.61153	842,447.06
233,913.45	0.2979735	2	2	11,543.890	14,820.920	69,700.01	4.88910	1,143,627.09	4.57084	1,069,180.62
234,688.54	0.2969894	2	2	12,195.380	14,190.920	69,700.01	4.82585	1,132,571.84	4.63201	1,087,080.07
243,315.46	3.4428967	2	2	8,507.930	21,761.030	837,710.00	5.18387	1,261,314.52	3.89695	948,189.16
267,725.92	0.3125958	2	1	9,006.170	17,607.630	83,690.00	4.08459	1,093,550.86	3.24931	869,924.27
270,724.84	0.2867857	1	2	10,704.730	15,635.020	77,640.01	3.99088	1,080,429.74	3.51209	950,809.88
270,784.26	0.2865750	1	2	10,969.190	15,409.410	77,600.00	3.96520	1,073,714.12	3.53400	956,950.58
290,987.02	0.2802530	1	2	9,808.700	16,501.060	81,549.99	4.07787	1,186,608.22	3.42800	997,502.67
334,177.84	0.5100877	1	0	10,019.890	22,341.110	170,460.01	1.95557	653,507.78	0.75905	253,657.09
336,020.72	2.0661187	1	2	10,897.300	23,005.560	694,258.70	3.97218	1,334,735.18	2.79641	939,651.75
402,499.21	2.2076565	2	1	14,963.281	11,135.480	888,579.99	3.50622	1,411,248.77	3.87775	1,560,793.27
415,890.92	0.2869576	2	2	7,709.570	20,926.930	119,343.06	5.26138	2,188,159.26	3.97795	1,654,391.23
433,222.76	2.2068785	2	1	17,668.092	10,689.170	956,069.99	3.24360	1,405,203.48	3.92109	1,698,706.11
436,338.14	0.2869605	1	2	8,686.530	20,219.410	125,211.81	4.18682	1,826,871.34	3.06695	1,338,225.20
464,780.24	0.2539910	1	2	10,180.590	16,149.270	118,050.00	4.04177	1,878,533.19	3.46216	1,609,141.62
520,974.75	1.5900836	1	1	9,451.970	19,198.690	828,393.41	3.06161	1,595,020.59	2.11512	1,101,922.66
676,587.95	5.1293996	2	2	7,869.292	17,063.350	3,470,489.97	5.24587	3,549,292.74	4.35310	2,945,254.14
681,542.96	2.0661187	1	1	8,244.780	21,639.310	1,408,148.65	3.17881	2,166,498.51	1.87813	1,280,028.32
734,475.93	0.0653527	1	1	8,245.290	21,410.460	47,999.99	3.17876	2,334,726.23	1.90035	1,395,764.52
812,018.35	0.2511889	2	1	15,030.498	13,399.350	203,970.00	3.49969	2,841,811.66	3.65793	2,970,308.82
895,529.41	0.3461416	1	2	8,964.120	22,211.020	309,979.98	4.15987	3,725,289.13	2.87356	2,573,357.45
936,343.56	1.2692563	1	2	11,468.540	24,671.200	1,188,459.96	3.91672	3,667,395.03	2.63468	2,466,962.35

Note: All the figures are in 2001 Constant dollar.
Source: Author.

	Variables					Land Values				
	Dependent Variable	Significant Independent Variables				Current	Projections			
							Projection-1		Projection-2	
Area (Sqft)	Land Value/Sqft	Corner Lot	Lot Shape	[1]Distance to Second Nearest Interchange	[2]Distance to Second Nearest Interchange	Current Land Value	Projected Land Value/Sqft	[3]Projected Land Value	Projected Land Value/Sqft	[4]Projected Land Value
1,781,381.52	0.2905788	1	1	12,456.336	15,086.060	517,631.70	2.76991	4,934,274.21	2.51445	4,479,201.13
3,479,870.83	0.2892033	2	1	14,983.540	12,095.630	1,006,390.13	3.50425	12,194,330.75	3.78452	13,169,655.81
						14,352,888.39		**66,275,365.78**		**57,018,465.59**

[1] It is calculated under the assumption that new highway interchange is in place

[2] It is calculated under existing conditions

[3] Land value is projected under the assumption that the construction of proposed interchange will finish by 2010 and also the proposed land use plan will be adopted by 2010.

[4] Land value projected under the assumption that there will not be any interchange constructed by 2010 but the proposed land use plan will be adopted by 2010.

Note: All the figures are in 2001 Constant dollar.
Source: Author.

APPENDIX 2: Detailed Output of Regression Model-1

REGRESSION OUTPUT FOR COMMERCIAL PROPERTIES

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 1

Variable corlt Entered: R-Square = 0.3860 and C(p) = 29.6640

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	481.74287	481.74287	33.94	<.0001
Error	54	766.45516	14.19361		
Corrected Total	55	1248.19803			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	1.96234	0.94651	61.00833	4.30	0.0429
corlt	4.08584	0.70133	481.74287	33.94	<.0001

Bounds on condition number: 1, 1

Stepwise Selection: Step 2

Variable lsh Entered: R-Square = 0.5300 and C(p) = 12.5041

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	661.56780	330.78390	29.89	<.0001
Error	53	586.63023	11.06849		
Corrected Total	55	1248.19803			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-1.92283	1.27582	25.14137	2.27	0.1377
corlt	3.61409	0.63029	363.92524	32.88	<.0001
lsh	2.72265	0.67548	179.82493	16.25	0.0002

Bounds on condition number: 1.0357, 4.1428

Stepwise Selection: Step 3

Variable interlinv Entered: R-Square = 0.6180 and C(p) = 2.8034

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	771.38402	257.12801	28.04	<.0001
Error	52	476.81401	9.16950		
Corrected Total	55	1248.19803			

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 3

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-3.35025	1.23231	67.77357	7.39	0.0089
interlinv	6.08183	1.75741	109.81622	11.98	0.0011
corlt	2.88619	0.61102	204.59179	22.31	<.0001
lsh	2.29171	0.62729	122.38462	13.35	0.0006

Bounds on condition number: 1.2103, 10.39

Stepwise Selection: Step 4

Variable CBD Entered: R-Square = 0.6377 and C(p) = 2.1833

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	795.97470	198.99368	22.44	<.0001
Error	51	452.22333	8.86712		
Corrected Total	55	1248.19803			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-4.30910	1.34165	91.46932	10.32	0.0023
interlinv	5.59712	1.75253	90.44396	10.20	0.0024
corlt	2.22756	0.71934	85.02884	9.59	0.0032
lsh	2.12757	0.62469	102.85534	11.60	0.0013
CBD	1.45875	0.87597	24.59068	2.77	0.1020

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 4

Bounds on condition number: 1.7292, 23.054

All variables left in the model are significant at the 0.1500 level.

No other variable met the 0.1500 significance level for entry into the model.

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	corlt		1	0.3860	0.3860	29.6640	33.94	<.0001
2	lsh		2	0.1441	0.5300	12.5041	16.25	0.0002
3	interlinv		3	0.0880	0.6180	2.8034	11.98	0.0011
4	CBD		4	0.0197	0.6377	2.1833	2.77	0.1020

Model Crossproducts X'X X'Y Y'Y

Variable	Intercept	interlinv	corlt
Intercept	56	27.251053409	64
interlinv	27.251053409	16.854286277	34.95207712
corlt	64	34.95207712	102
lsh	91	46.661644155	109
CBD	85	44.544150906	112
LD	371.384502	219.02060387	542.344998

Regression Analysis of Land Uses commercial data

The REG Procedure

Model Crossproducts X'X X'Y Y'Y

Variable	lsh	CBD	LD
Intercept	91	85	371.384502
interlinv	46.661644155	44.544150906	219.02060387
corlt	109	112	542.344998
lsh	173	144	689.9768024
CBD	144	149	656.2563375
LD	689.9768024	656.2563375	3711.1703225

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

X'X Inverse, Parameter Estimates, and SSE

Variable	Intercept	interlinv	corlt
Intercept	0.2030006508	-0.060153488	0.0057314778
interlinv	-0.060153488	0.3463777237	-0.027329848
corlt	0.0057314778	-0.027329848	0.0583567241
lsh	-0.046821914	-0.02063067	0.0001102043
CBD	-0.056880129	-0.028753663	-0.03907123
LD	-4.309098761	5.597121976	2.227555798

X'X Inverse, Parameter Estimates, and SSE

Variable	lsh	CBD	LD
Intercept	-0.046821914	-0.056880129	-4.309098761
interlinv	-0.02063067	-0.028753663	5.597121976
corlt	0.0001102043	-0.03907123	2.227555798
lsh	0.0440090538	-0.009736968	2.1275728739
CBD	-0.009736968	0.0865350308	1.4587512956
LD	2.1275728739	1.4587512956	452.22332912

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F

Model	4	795.97470	198.99368	22.44	<.0001
Error	51	452.22333	8.86712		
Corrected Total	55	1248.19803			

Root MSE	2.97777	R-Square	0.6377
Dependent Mean	6.63187	Adj R-Sq	0.6093
Coeff Var	44.90096		

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Type I SS
Intercept	1	-4.30910	1.34165	-3.21	0.0023	2462.97229
interlinv	1	5.59712	1.75253	3.19	0.0024	408.13779
corlt	1	2.22756	0.71934	3.10	0.0032	240.86161
lsh	1	2.12757	0.62469	3.41	0.0013	122.38462
CBD	1	1.45875	0.87597	1.67	0.1020	24.59068

Parameter Estimates

Variable	DF	Type II SS	Standardized Estimate	Squared Semi-partial Corr Type I	Squared Partial Corr Type I
Intercept	1	91.46932	0	.	.
interlinv	1	90.44396	0.30031	0.32698	0.32698
corlt	1	85.02884	0.33870	0.19297	0.28672
lsh	1	102.85534	0.30185	0.09805	0.20425
CBD	1	24.59068	0.18457	0.01970	0.05157

Parameter Estimates

Variable	DF	Squared Semi-partial Corr Type II	Squared Partial Corr Type II	Tolerance	Variance Inflation
Intercept	1	.	.	.	0
interlinv	1	0.07246	0.16667	0.80346	1.24461
corlt	1	0.06812	0.15827	0.59382	1.68401
lsh	1	0.08240	0.18530	0.90438	1.10573
CBD	1	0.01970	0.05157	0.57832	1.72916

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Parameter Estimates

Variable	DF	95% Confidence Limits	
Intercept	1	-7.00258	-1.61562
interlinv	1	2.07876	9.11548
corlt	1	0.78341	3.67170
lsh	1	0.87346	3.38168
CBD	1	-0.29982	3.21733

Covariance of Estimates

Variable	Intercept	interlinv	corlt	lsh	CBD
Intercept	1.8000319635	-0.533388442	0.0508217246	-0.415175723	-0.504363159
interlinv	-0.533388442	3.0713742616	-0.242337151	-0.182934708	-0.254962296
corlt	0.0508217246	-0.242337151	0.5174563143	0.0009771949	-0.346449445
lsh	-0.415175723	-0.182934708	0.0009771949	0.3902337417	-0.086338905
CBD	-0.504363159	-0.254962296	-0.346449445	-0.086338905	0.7673168574

Correlation of Estimates

Variable	Intercept	interlinv	corlt	lsh	CBD
Intercept	1.0000	-0.2268	0.0527	-0.4954	-0.4292
interlinv	-0.2268	1.0000	-0.1922	-0.1671	-0.1661
corlt	0.0527	-0.1922	1.0000	0.0022	-0.5498
lsh	-0.4954	-0.1671	0.0022	1.0000	-0.1578
CBD	-0.4292	-0.1661	-0.5498	-0.1578	1.0000

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Sequential Parameter Estimates

Intercept	interlinv	corlt	lsh	CBD
6.631866	0	0	0	0
1.445574	10.657657	0	0	0
-0.508024	7.356354	3.115085	0	0
-3.350251	6.081833	2.886193	2.291712	0
-4.309099	5.597122	2.227556	2.127573	1.458751

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Consistent Covariance of Estimates

Variable	Intercept	interlinv	corlt	lsh	CBD
Intercept	1.7184538897	-0.967922368	0.222110793	-0.218756849	-0.664799545
interlinv	-0.967922368	3.3572166849	-0.30649399	-0.144851065	0.095351956
corlt	0.222110793	-0.30649399	0.5836781043	-0.035829534	-0.411113977
lsh	-0.218756849	-0.144851065	-0.035829534	0.3612916302	-0.175782164
CBD	-0.664799545	0.095351956	-0.411113977	-0.175782164	0.8392229159

Test of First and Second
Moment Specification

DF	Chi-Square	Pr > ChiSq
14	20.32	0.1205

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

Obs	Dep Var LD	Predicted Value	Std Error Mean Predict	95% CL Mean

1	21.6225	13.3747	1.0335	11.2999	15.4496
2	1.0983	0.6058	0.8110	-1.0224	2.2341
3	1.1769	7.5850	1.1358	5.3047	9.8653
4	0.2796	3.1729	0.8311	1.5043	4.8414
5	0.1147	3.2911	0.8273	1.6303	4.9519
6	0.1146	3.3353	0.8262	1.6765	4.9940
7	1.8356	0.9953	0.7993	-0.6095	2.6000
8	6.8753	4.2766	0.8841	2.5017	6.0515
9	4.7663	2.7809	0.6930	1.3896	4.1721
10	11.7082	5.9814	0.6422	4.6923	7.2706
11	11.6909	8.5251	1.0697	6.3777	10.6726
12	6.8728	6.3359	0.8461	4.6372	8.0345
13	1.8352	4.2484	0.8564	2.5291	5.9677
14	5.9735	-0.2762	1.1082	-2.5010	1.9486
15	3.0949	4.3080	1.3781	1.5412	7.0747
16	12.0029	10.0172	0.6771	8.6579	11.3765
17	6.9473	6.3663	0.8399	4.6801	8.0525
18	6.8761	8.5389	0.9439	6.6440	10.4338
19	1.8362	4.6699	0.9011	2.8608	6.4790
20	3.6102	8.5020	0.7889	6.9182	10.0858
21	1.1465	2.0232	1.2066	-0.3991	4.4455
22	3.4534	5.9902	0.6419	4.7016	7.2789
23	0.7462	0.2706	1.1109	-1.9595	2.5008
24	3.4332	9.0049	0.7005	7.5986	10.4112
25	11.9684	8.5941	0.6591	7.2709	9.9172
26	0.7444	0.3370	1.1053	-1.8819	2.5560
27	6.8719	4.6601	0.8328	2.9883	6.3320
28	6.1312	4.4918	0.8289	2.8277	6.1560
29	6.7818	6.5623	0.8016	4.9530	8.1716
30	6.9081	6.4116	0.8308	4.7436	8.0795
31	11.8763	9.2100	0.7288	7.7468	10.6731
32	6.8894	6.6859	0.7790	5.1220	8.2497
33	7.9416	7.6731	0.7924	6.0823	9.2640
34	11.8277	12.2364	0.7834	10.6636	13.8092

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

Obs	95% CL Predict		Residual	Std Error Residual	Student Residual	-2-1 0	1 2
1	7.0468	19.7027	8.2477	2.793	2.953		*****
2	-5.5901	6.8017	0.4924	2.865	0.172		
3	1.1867	13.9833	-6.4080	2.753	-2.328	****	
4	-3.0337	9.3795	-2.8932	2.859	-1.012	**	
5	-2.9134	9.4956	-3.1764	2.861	-1.110	**	
6	-2.8687	9.5393	-3.2207	2.861	-1.126	**	
7	-5.1945	7.1850	0.8403	2.868	0.293		
8	-1.9594	10.5126	2.5987	2.844	0.914		*
9	-3.3570	8.9188	1.9855	2.896	0.686		*
10	-0.1341	12.0970	5.7268	2.908	1.970		***
11	2.1730	14.8773	3.1658	2.779	1.139		**
12	0.1211	12.5506	0.5369	2.855	0.188		
13	-1.9721	10.4689	-2.4132	2.852	-0.846	*	
14	-6.6549	6.1025	6.2497	2.764	2.261		****
15	-2.2794	10.8953	-1.2131	2.640	-0.460		
16	3.8865	16.1479	1.9856	2.900	0.685		*
17	0.1549	12.5777	0.5810	2.857	0.203		
18	2.2677	14.8102	-1.6628	2.824	-0.589	*	
19	-1.5760	10.9158	-2.8338	2.838	-0.998	*	
20	2.3176	14.6864	-4.8918	2.871	-1.704	***	
21	-4.4271	8.4734	-0.8766	2.722	-0.322		
22	-0.1252	12.1057	-2.5368	2.908	-0.872	*	
23	-6.1099	6.6512	0.4756	2.763	0.172		
24	2.8636	15.1462	-5.5717	2.894	-1.925	***	
25	2.4713	14.7169	3.3744	2.904	1.162		**
26	-6.0396	6.7137	0.4073	2.765	0.147		

27	-1.5474	10.8676	2.2118	2.859	0.774		*
28	-1.7136	10.6973	1.6393	2.860	0.573		*
29	0.3713	12.7532	0.2195	2.868	0.0765		
30	0.2051	12.6180	0.4965	2.860	0.174		
31	3.0554	15.3645	2.6663	2.887	0.923		*
32	0.5066	12.8652	0.2035	2.874	0.0708		
33	1.4869	13.8593	0.2684	2.870	0.0935		
34	6.0549	18.4180	-0.4087	2.873	-0.142		

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

Obs	Cook's D
1	0.239
2	0.000
3	0.185
4	0.017
5	0.021
6	0.021
7	0.001
8	0.016
9	0.005
10	0.038
11	0.038
12	0.001
13	0.013
14	0.164
15	0.012
16	0.005
17	0.001
18	0.008
19	0.020
20	0.044
21	0.004
22	0.007
23	0.001
24	0.043
25	0.014
26	0.001
27	0.010
28	0.006
29	0.000
30	0.001
31	0.011
32	0.000
33	0.000
34	0.000

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

Obs	Dep Var LD	Predicted Value	Std Error Mean Predict	95% CL Mean	
35	6.8255	6.9131	0.7408	5.4258	8.4003
36	6.1146	2.8597	0.6829	1.4886	4.2307
37	1.2575	3.7065	0.8268	2.0466	5.3663
38	6.8775	8.8728	0.8694	7.1275	10.6181
39	1.2668	-0.1736	1.2276	-2.6382	2.2909
40	5.9840	7.6355	0.9949	5.6381	9.6329
41	12.0117	11.7096	0.6996	10.3050	13.1142
42	11.9620	10.7580	0.6348	9.4837	12.0324

43	1.2342	2.8478	1.1779	0.4830	5.2126
44	0.7364	1.2086	1.0673	-0.9341	3.3513
45	11.9846	8.4689	0.6510	7.1620	9.7759
46	8.0143	9.6816	0.7205	8.2352	11.1279
47	8.0203	9.8435	0.6979	8.4424	11.2446
48	11.9849	11.1944	0.6485	9.8925	12.4964
49	7.9880	9.9539	0.8644	8.2185	11.6892
50	11.9607	10.2668	0.6540	8.9538	11.5798
51	12.0292	9.3990	0.7588	7.8756	10.9223
52	11.9935	12.3530	0.8054	10.7362	13.9699
53	11.9852	12.2598	0.7877	10.6784	13.8413
54	11.9766	14.9353	1.4505	12.0233	17.8474
55	12.0219	10.0188	0.6769	8.6598	11.3778
56	0.1032	5.8858	1.2623	3.3517	8.4199

Output Statistics

```
                                            Std Error   Student
Obs      95% CL Predict        Residual     Residual   Residual      -2-1 0 1 2

 35      0.7527   13.0734     -0.0876        2.884    -0.0304    |       |       |
 36     -3.2737    8.9930      3.2550        2.898     1.123     |       |**     |
 37     -2.4978    9.9107     -2.4490        2.861    -0.856     |      *|       |
 38      2.6451   15.1005     -1.9953        2.848    -0.701     |      *|       |
 39     -6.6398    6.2926      1.4405        2.713     0.531     |       |*      |
 40      1.3325   13.9385     -1.6516        2.807    -0.588     |      *|       |
```

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

```
                                            Std Error   Student
Obs      95% CL Predict        Residual     Residual   Residual      -2-1 0 1 2

 41      5.5687   17.8505      0.3021        2.894     0.104     |       |       |
 42      4.6456   16.8705      1.2039        2.909     0.414     |       |       |
 43     -3.5810    9.2767     -1.6137        2.735    -0.590     |      *|       |
 44     -5.1419    7.5591     -0.4721        2.780    -0.170     |       |       |
 45      2.3496   14.5883      3.5157        2.906     1.210     |       |**     |
 46      3.5310   15.8322     -1.6672        2.889    -0.577     |      *|       |
 47      3.7034   15.9836     -1.8232        2.895    -0.630     |      *|       |
 48      5.0762   17.3127      0.7904        2.906     0.272     |       |       |
 49      3.7289   16.1788     -1.9659        2.850    -0.690     |      *|       |
 50      4.1461   16.3874      1.6939        2.905     0.583     |       |*      |
 51      3.2298   15.5681      2.6302        2.879     0.913     |       |*      |
 52      6.1601   18.5460     -0.3595        2.867    -0.125     |       |       |
 53      6.0761   18.4436     -0.2746        2.872    -0.0956    |       |       |
 54      8.2857   21.5850     -2.9587        2.601    -1.138     |     **|       |
 55      3.8882   16.1495      2.0031        2.900     0.691     |       |*      |
 56     -0.6073   12.3789     -5.7826        2.697    -2.144     |   ****|       |
```

Output Statistics

Obs	Cook's D
35	0.000
36	0.014
37	0.012
38	0.009
39	0.012
40	0.009
41	0.000
42	0.002
43	0.013
44	0.001
45	0.015
46	0.004

Regression Analysis of Land Uses commercial data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

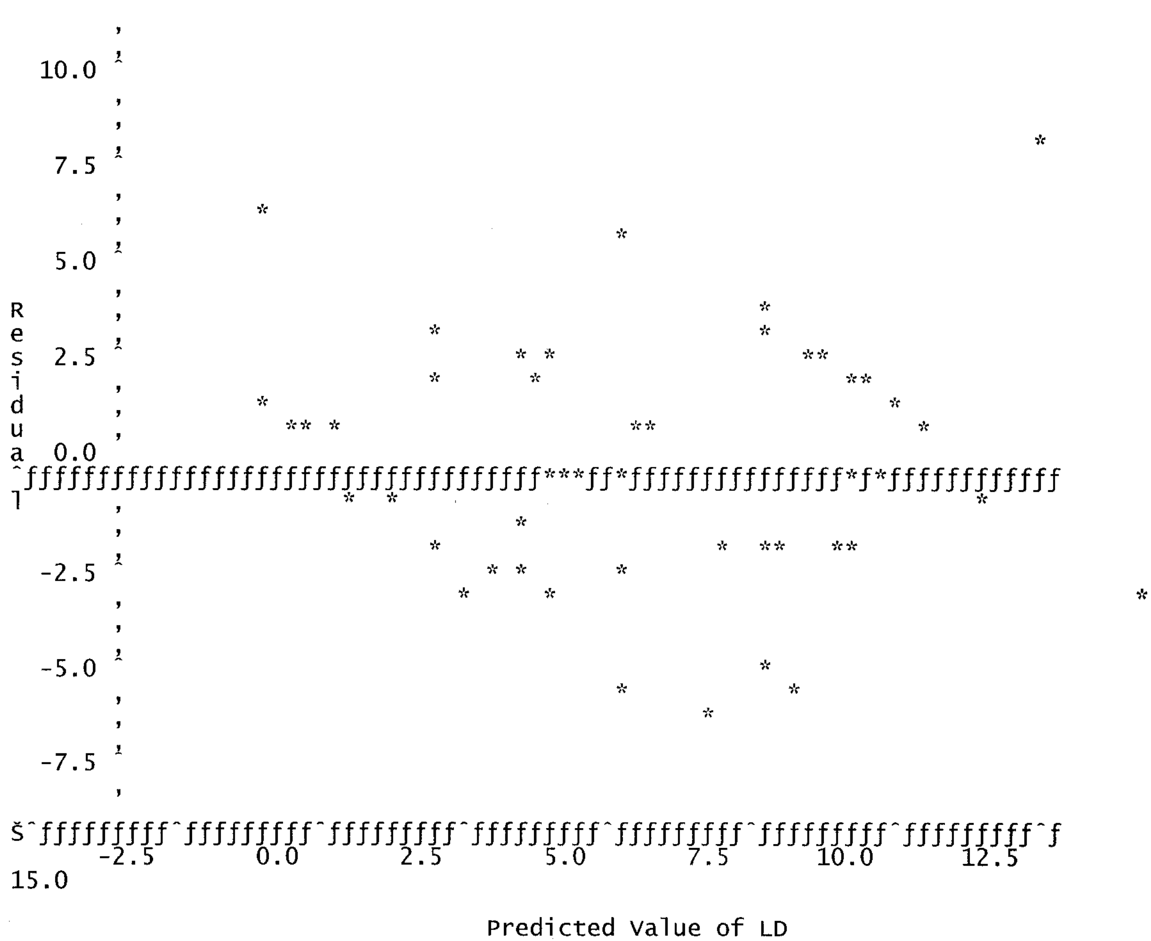
Output Statistics

Obs	Cook's D
47	0.005
48	0.001
49	0.009
50	0.003
51	0.012
52	0.000
53	0.000
54	0.081
55	0.005
56	0.201

Sum of Residuals	0
Sum of Squared Residuals	452.22333
Predicted Residual SS (PRESS)	564.58432

Regression Analysis of Land Uses commercial data

Plot of resid*Pred. Symbol used is '*'.



NOTE: 8 obs hidden.

Regression Analysis of Land Uses commercial data

```
                          Plot of resid*lsh.  Symbol used is '#'.

          ,
   10.0 ˆ
          ,
          ,                                                                  #
    7.5 ˆ
          ,
          ,                               #
          ,                                                                  #
    5.0 ˆ
          ,
R         ,                                                                  #
e         ,                               #                                  #
s   2.5 ˆ                                 #                                  #
i         ,                               #                                  #
d         ,#                                                                 #
u         ,#                              #                                  #
a   0.0
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ#ƒ
l         ,#                                                                 #
          ,                                                                  #
          ,#                              #                                  #
   -2.5 ˆ                                                                    #
          ,                                                                  #
          ,
   -5.0 ˆ                                 #
          ,#                                                                 #
          ,                                                                  #
   -7.5 ˆ
          ,
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
          0                                1                                  2

                                          lsh

NOTE: 28 obs hidden.
```

```
                    Regression Analysis of Land Uses commercial data

                          Plot of resid*LD.  Symbol used is '*'.

          ,
   10.0 ˆ
          ,
          ,                                                           *
    7.5 ˆ
          ,
          ,                *
          ,                               *
    5.0 ˆ
          ,
R         ,                                *
e         ,                *              **
s   2.5 ˆ                    *            **
i         ,             *   *             **
d         ,    *                          *
u         ,  ** *            *             *
a   0.0
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ*ƒƒ*ƒƒƒƒƒƒƒƒƒƒƒ*ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
l         ,  **                           **
          ,          *
          ,   *             * *  *
   -2.5 ˆ     **     *
          ,**   *                          *
          ,
```

```
  -5.0 ˆ            *
       ‚*           *
       ‚    *
  -7.5 ˆ
       ‚
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
        0             5            10            15            20            25

                                        LD
```

NOTE: 12 obs hidden.

Regression Analysis of Land Uses commercial data

Plot of resid*inter1inv. Symbol used is '*'.

```
       ‚
  10.0 ˆ
       ‚
       ‚                                                  *
   7.5 ˆ
       ‚
       ‚                 *
       ‚                     *
   5.0 ˆ
       ‚
R      ‚                                *
e      ‚          *           *          *
s  2.5 ˆ          *  *                         **
i      ‚      *  *            * *
d      ‚                      *          *
u      ‚      ** **  *                       *
a  0.0 ‚
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒ**ƒ*ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ*ƒƒ*ƒƒƒƒ*ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
l      ‚                 *  *                       **
       ‚                    *
       ‚         *  *        * *         *           **
  -2.5 ˆ                     *   *
       ‚                 **            *                                   *
       ‚
  -5.0 ˆ                                *
       ‚                         *           *
       ‚               *
  -7.5 ˆ
       ‚
Šˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒ
      0.0       0.2       0.4       0.6       0.8       1.0       1.2
1.4

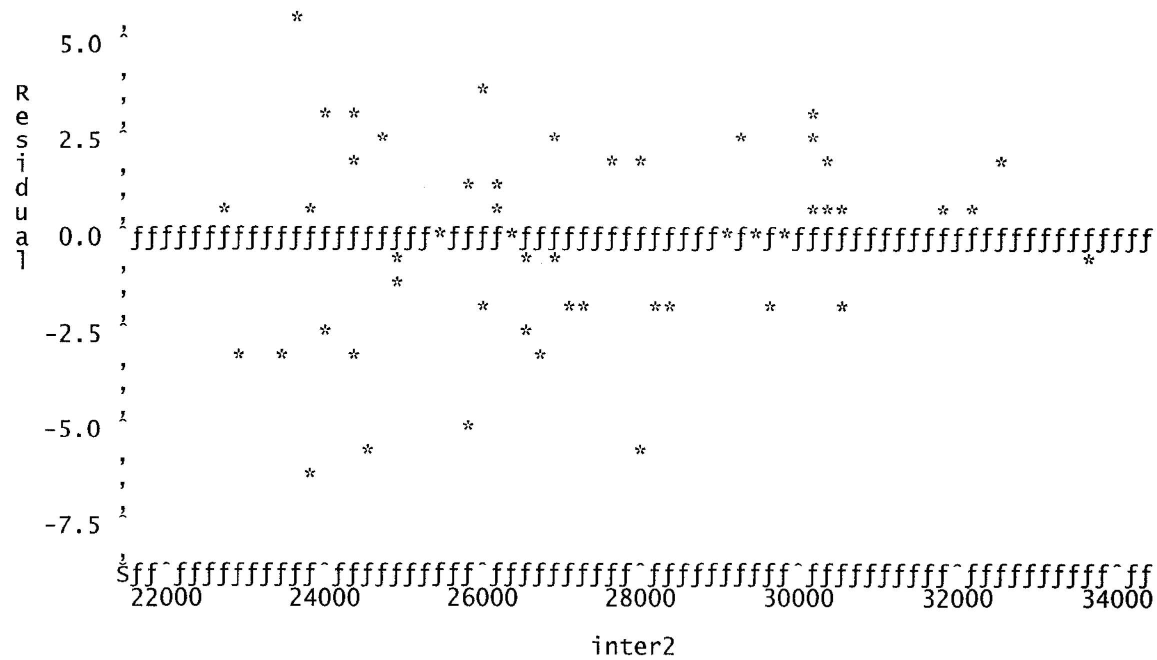
                                    inter1inv
```

NOTE: 5 obs hidden.

Regression Analysis of Land Uses commercial data

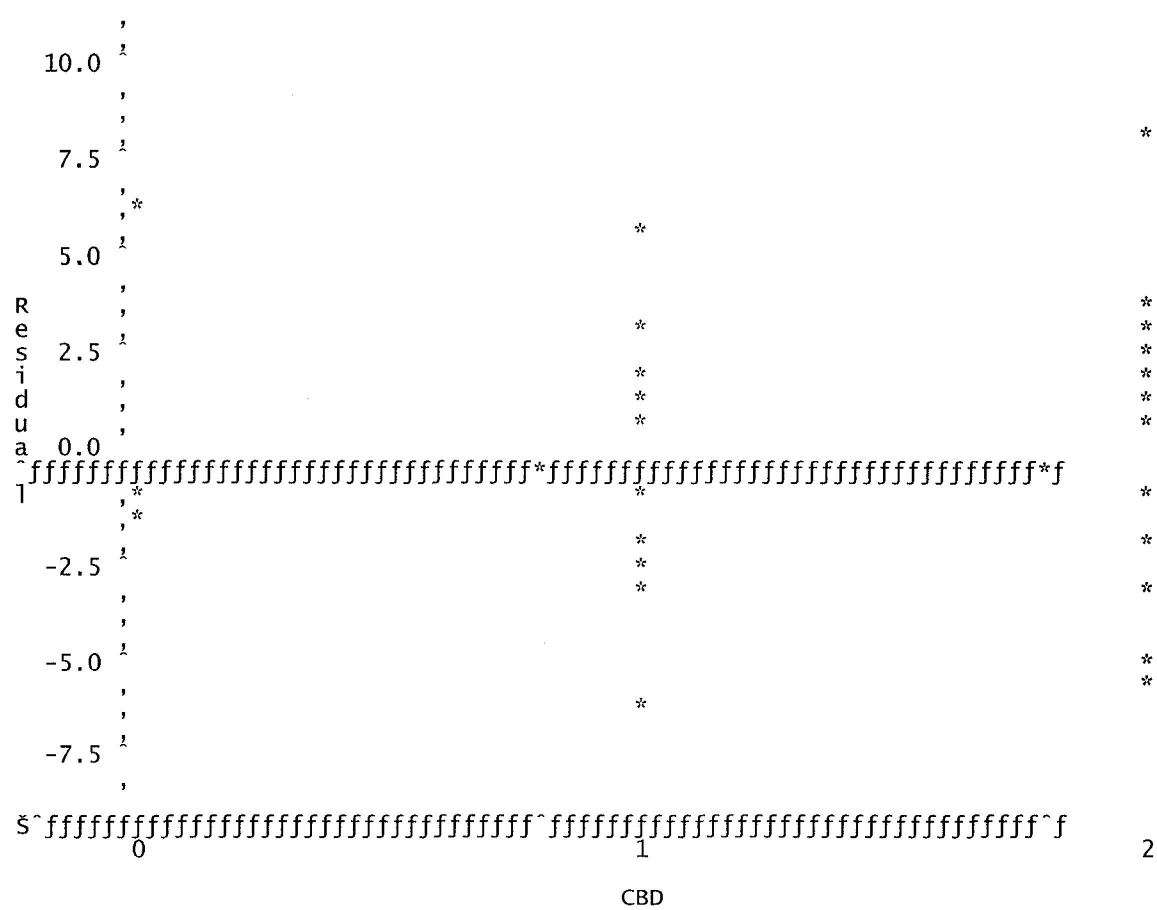
Plot of resid*inter2. Symbol used is '*'.

```
       ‚
  10.0 ˆ
       ‚
       ‚                              *
   7.5 ˆ
       ‚                       *
       ‚
```



NOTE: 3 obs hidden.

Regression Analysis of Land Uses commercial data
Plot of resid*CBD. Symbol used is '*'.



NOTE: 29 obs hidden.

```
          Regression Analysis of Land Uses commercial data
             Plot of resid*adjlu.  Symbol used is '*'.

             ‚
        10.0 ˆ
             ‚
             ‚                                                   *
         7.5 ˆ
             ‚                                                   *
             ‚                                                   *
         5.0 ˆ
             ‚
     R       ‚                                                   *
     e       ‚                                                   *
     s   2.5 ˆ                                                   *
     i       ‚  *                                                *
     d       ‚                                                   *
     u       ‚  *                                                *
     a   0.0 ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ*ƒƒ
     l       ‚                                                   *
             ‚                                                   *
             ‚                                                   *
        -2.5 ˆ                                                   *
             ‚  *                                                *
             ‚
        -5.0 ˆ                                                   *
             ‚                                                   *
             ‚                                                   *
        -7.5 ˆ
             ‚
             Šƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒ
                1                                                2

                                     adjlu
```

NOTE: 35 obs hidden.

```
          Regression Analysis of Land Uses commercial data

             Plot of resid*adjrd.  Symbol used is '#'.

          ‚
    10.0 ˆ
          ‚
          ‚                                                                #
     7.5 ˆ
          ‚
          ‚#
     5.0 ˆ                                                                 #
          ‚
R         ‚                                                                #
e         ‚                                  #                             #
s    2.5 ˆ                                  #                             #
i         ‚#                                 #                             #
d         ‚                                  #                             #
u         ‚#                                 #                             #
a    0.0
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ#ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ#ƒ
l         ‚                                  #                             #
          ‚#
          ‚                                  #                             #
    -2.5 ˆ                                  #                             #
          ‚                                                                #
          ‚
          ‚
```

```
  -5.0 ˆ                                                                  #
       ‚                                                                  #
       ‚                                                                  #
  -7.5 ˆ
       ‚
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
       0                                  1                                  2

                                        adjrd

NOTE: 27 obs hidden.
                Regression Analysis of Land Uses commercial data
                   Plot of resid*corlt.  Symbol used is '&'.

       ‚
  10.0 ˆ
       ‚
       ‚                                                                  &
   7.5 ˆ
       ‚
       ‚&
       ‚                                  &
   5.0 ˆ
       ‚
R      ‚                                  &
e      ‚                                  &                               &
s  2.5 ˆ                                  &
i      ‚                                  &                               &
d      ‚&                                                                 &
u      ‚&                                 &                               &
a  0.0
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ&ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ&ƒ
l      ‚&                                 &                               &
       ‚                                  &
       ‚                                  &                               &
  -2.5 ˆ&                                 &
       ‚&                                                                 &
       ‚
  -5.0 ˆ                                                                  &
       ‚                                  &                               &
       ‚                                                                  &
  -7.5 ˆ
       ‚
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
       0                                  1                                  2

                                        corlt

NOTE: 26 obs hidden.
                Regression Analysis of Land Uses commercial data

                   Plot of resid*distch.  Symbol used is '$'.

       ‚
  10.0 ˆ
       ‚
       ‚                           $
   7.5 ˆ
       ‚
       ‚                    $
       ‚            $
   5.0 ˆ
       ‚
```

```
R      ,                       $
e      ˆ             $  $                           $
s  2.5 ˆ                 $          $           $    $
i      ,                $              $  $          $          $
d      ,                      $  $
u      ,       $     $         $                     $$      $ $
a  0.0 ˆ
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ$ƒƒƒƒ$ƒƒƒƒƒƒƒƒƒƒƒƒ$ƒ$$ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
l      ,                  $       $ $                                 $
       ,                  $
       ,                       $     $     $     $    $
  -2.5 ˆ                $          $
       ,        $  $   $            $
       ,
  -5.0 ˆ                       $
       ,                 $                $
       ,            $
  -7.5 ˆ
       ,
Šˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒ
      2000      4000      6000      8000      10000     12000     14000
16000

                                        distch
```

NOTE: 6 obs hidden.

Regression Analysis of Land Uses commercial data

Plot of resid*distsh. Symbol used is '&'.

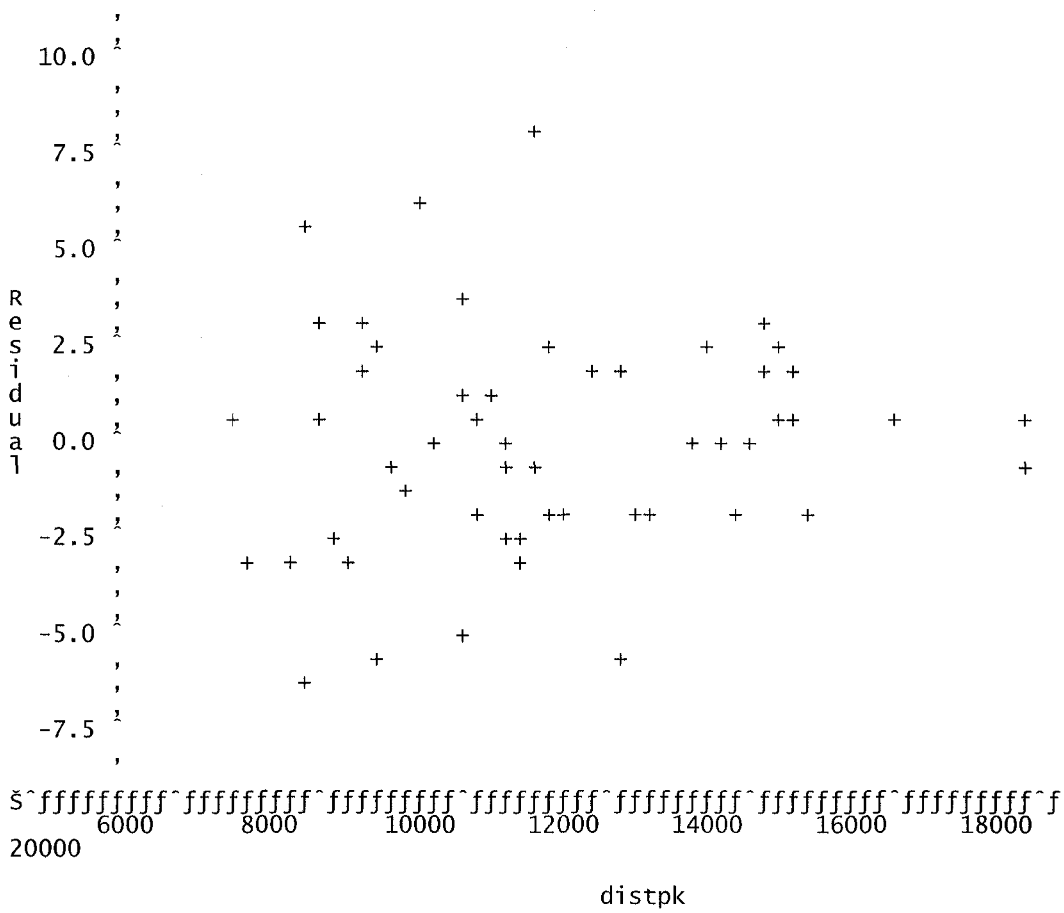
```
       ,
  10.0 ˆ
       ,
       ,
                                                      &
   7.5 ˆ
       ,
       ,                                         &
                                 &
   5.0 ˆ
       ,
R      ,                                                &
e      ˆ              &             &    &
s  2.5 ˆ                   &  &             &                      &
i      ,          &&                     & &                             &
d      ,                                              &    &
u      ,      &       &   &  &   &&                         &
a  0.0 ˆ                        &      &  &          &&        &
l      ,                        &           &                  &   &
       ,                                     &
       ,                       &        &&         &   &         &
  -2.5 ˆ                             &                       &
       ,                 &     &      &                     &
       ,
  -5.0 ˆ                                              &
       ,                                  &&
       ,                          &
  -7.5 ˆ
       ,
Šˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒˆƒ
      1000      2000      3000      4000      5000      6000      7000
8000

                                        distsh
```

NOTE: 4 obs hidden.

Regression Analysis of Land Uses commercial data

Plot of resid*distpk. Symbol used is '+'.



NOTE: 3 obs hidden.

Regression Analysis of Land Uses commercial data

The UNIVARIATE Procedure
Variable: resid (Residual)

Moments

N	56	Sum Weights	56
Mean	0	Sum Observations	0
Std Deviation	2.86744526	Variance	8.22224235
Skewness	0.21915847	Kurtosis	0.70116773
Uncorrected SS	452.223329	Corrected SS	452.223329
Coeff Variation	.	Std Error Mean	0.38317849

Basic Statistical Measures

Location		Variability	
Mean	0.000000	Std Deviation	2.86745
Median	0.243969	Variance	8.22224
Mode	.	Range	14.65578
		Interquartile Range	3.73425

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	0	Pr > |t|	1.0000
Sign	M	2	Pr >= |M|	0.6889
Signed Rank	S	8	Pr >= |S|	0.9487

Tests for Normality

Test	--Statistic---		-----p Value------	
Shapiro-Wilk	W	0.981008	Pr < W	0.5199
Kolmogorov-Smirnov	D	0.064	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.047726	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.343283	Pr > A-Sq	>0.2500

Regression Analysis of Land Uses commercial data

The UNIVARIATE Procedure
Variable: resid (Residual)

Quantiles (Definition 5)

Quantile	Estimate
100% Max	8.247737
99%	8.247737
95%	5.726796
90%	3.254969
75% Q3	1.839687
50% Median	0.243969
25% Q1	-1.894558
10%	-3.176440
5%	-5.571734
1%	-6.408040
0% Min	-6.408040

Extreme Observations

------Lowest-----		-----Highest-----	
Value	Obs	Value	Obs
-6.40804	3	3.37437	25
-5.78258	56	3.51565	45
-5.57173	24	5.72680	10
-4.89184	20	6.24974	14
-3.22068	6	8.24774	1

Regression Analysis of Land Uses commercial data
The UNIVARIATE Procedure
Variable: resid (Residual)

```
Stem Leaf                     #             Boxplot
   8 2                        1                0
   7
   6 2                        1                |
   5 7                        1                |
   4                                           |
   3 2345                     4                |
   2 0002667                  7                |
   1 2467                     4             +-----+
   0 223345555688            12             *--+--*
  -0 954431                   6             |     |
  -1 877762                   6             +-----+
  -2 9854400                  7                |
  -3 220                      3                |
  -4 9                        1                |
  -5 86                       2                |
  -6 4                        1                |
     ----+----+----+----+
```

```
                   Normal Probability Plot
 8.5+                                                *
    |                                                  +
    |                                            * ++++
 5.5+                                          *+++
    |                                       ++++
    |                                    +****
 2.5+                                +****
    |                             +****
    |                        ******
-0.5+                      ***
    |                 *****
    |             *****+
-3.5+           **++
    |        ++*+
    |     +*+*
-6.5+ +*++
     +----+----+----+----+----+----+----+----+----+----+----+
         -2        -1         0        +1        +2
```

APPENDIX 3: Detailed Output of Regression Model-2

REGRESSION OUTPUT FOR OFFICE, OFFICE/WAREHOUSE, and MIXED USE

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 1

Variable corlt Entered: R-Square = 0.3394 and C(p) = 14.0514

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	27.48190	27.48190	17.98	0.0002
Error	35	53.48393	1.52811		
Corrected Total	36	80.96583			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	1.02446	0.40622	9.71880	6.36	0.0164
corlt	1.22645	0.28920	27.48190	17.98	0.0002

Bounds on condition number: 1, 1

Stepwise Selection: Step 2

Variable inter2 Entered: R-Square = 0.4322 and C(p) = 9.4443

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	34.99231	17.49616	12.94	<.0001
Error	34	45.97351	1.35216		
Corrected Total	36	80.96583			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	2.77847	0.83661	14.91402	11.03	0.0022
corlt	1.17434	0.27294	25.03053	18.51	0.0001
inter2	-0.00008629	0.00003661	7.51041	5.55	0.0243

Bounds on condition number: 1.0066, 4.0264

Stepwise Selection: Step 3

Variable lsh Entered: R-Square = 0.5356 and C(p) = 4.0809

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	43.36240	14.45413	12.68	<.0001
Error	33	37.60343	1.13950		
Corrected Total	36	80.96583			

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Stepwise Selection: Step 3

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	1.94867	0.82679	6.32998	5.56	0.0245
corlt	0.97970	0.26065	16.09845	14.13	0.0007
lsh	1.05094	0.38777	8.37008	7.35	0.0106
inter2	-0.00009709	0.00003384	9.37671	8.23	0.0071

Bounds on condition number: 1.0913, 9.6041

All variables left in the model are significant at the 0.1500 level.

No other variable met the 0.1500 significance level for entry into the model.

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	corlt		1	0.3394	0.3394	14.0514	17.98	0.0002
2	inter2		2	0.0928	0.4322	9.4443	5.55	0.0243
3	lsh		3	0.1034	0.5356	4.0809	7.35	0.0106

Regression Analysis of Land Uses O_W_MU data

The REG Procedure

Model Crossproducts X'X X'Y Y'Y

Variable	Intercept	corlt	lsh	inter2	LD
Intercept	37	45	45	724958.94	93.0953412
corlt	45	73	58	870671.55	135.6316904
lsh	45	58	63	890100.12	124.3046246
inter2	724958.94	870671.55	890100.12	15219907927	1723486.0757
LD	93.0953412	135.6316904	124.3046246	1723486.0757	315.20211022

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

X'X Inverse, Parameter Estimates, and SSE

Variable	Intercept	corlt	lsh	inter2	LD
Intercept	0.5998919877	-0.059443425	-0.104189126	-0.00001908	1.948666599
corlt	-0.059443425	0.0596214147	-0.024438369	8.4993738E-7	0.9797001931
lsh	-0.104189126	-0.024438369	0.1319550342	-1.356287E-6	1.0509399543
inter2	-0.00001908	8.4993738E-7	-1.356287E-6	1.0052461E-9	-0.000097087
LD	1.948666599	0.9797001931	1.0509399543	-0.000097087	37.603428605

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	43.36240	14.45413	12.68	<.0001
Error	33	37.60343	1.13950		
Corrected Total	36	80.96583			

Root MSE	1.06747	R-Square	0.5356
Dependent Mean	2.51609	Adj R-Sq	0.4933
Coeff Var	42.42585		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Type I SS
Intercept	1	1.94867	0.82679	2.36	0.0245	234.23629
corlt	1	0.97970	0.26065	3.76	0.0007	27.48190
lsh	1	1.05094	0.38777	2.71	0.0106	6.50379
inter2	1	-0.00009709	0.00003384	-2.87	0.0071	9.37671

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Parameter Estimates

Variable	DF	Type II SS	Standardized Estimate	Squared Semi-partial Corr Type I	Squared Partial Corr Type I
Intercept	1	6.32998	0	.	.
corlt	1	16.09845	0.46539	0.33943	0.33943
lsh	1	8.37008	0.33588	0.08033	0.12160
inter2	1	9.37671	-0.34382	0.11581	0.19959

Parameter Estimates

Variable	DF	Squared Semi-partial Corr Type II	Squared Partial Corr Type II	Tolerance	Variance Inflation
Intercept	1	.	.	.	0
corlt	1	0.19883	0.29977	0.91802	1.08930
lsh	1	0.10338	0.18206	0.91634	1.09130
inter2	1	0.11581	0.19959	0.97966	1.02076

Parameter Estimates

Variable	DF	95% Confidence Limits	
Intercept	1	0.26656	3.63078
corlt	1	0.44940	1.51000
lsh	1	0.26202	1.83986
inter2	1	-0.00016594	-0.00002823

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Covariance of Estimates

Variable	Intercept	corlt	lsh	inter2
Intercept	0.6835756222	-0.067735655	-0.118723284	-0.000021742
corlt	-0.067735655	0.0679384731	-0.027847469	9.6850181E-7
lsh	-0.118723284	-0.027847469	0.150362476	-1.545486E-6
inter2	-0.000021742	9.6850181E-7	-1.545486E-6	1.1454758E-9

Correlation of Estimates

Variable	Intercept	corlt	lsh	inter2
Intercept	1.0000	-0.3143	-0.3703	-0.7770
corlt	-0.3143	1.0000	-0.2755	0.1098
lsh	-0.3703	-0.2755	1.0000	-0.1178
inter2	-0.7770	0.1098	-0.1178	1.0000

Sequential Parameter Estimates

Intercept	corlt	lsh	inter2
2.516090	0	0	0
1.024458	1.226453	0	0
0.105870	1.061787	0.919949	0
1.948667	0.979700	1.050940	-0.000097087

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Consistent Covariance of Estimates

Variable	Intercept	corlt	lsh	inter2
Intercept	0.6092723459	-0.045404725	-0.004926044	-0.000023865
corlt	-0.045404725	0.0489397501	0.011741595	-1.072187E-6
lsh	-0.004926044	0.011741595	0.1626540397	-9.103547E-6
inter2	-0.000023865	-1.072187E-6	-9.103547E-6	1.5969271E-9

Test of First and Second
Moment Specification

DF	Chi-Square	Pr > ChiSq
9	11.29	0.2564

Regression Analysis of Land Uses O_W_MU data

The REG Procedure

Model: MODEL1
Dependent Variable: LD

Output Statistics

Obs	Dep Var LD	Predicted Value	Std Error Mean Predict	95% CL Mean	
1	3.6617	1.8552	0.4546	0.9303	2.7801
2	1.7944	2.7770	0.3101	2.1462	3.4079
3	1.1080	0.9303	0.5945	-0.2793	2.1399
4	1.3763	2.9485	0.3584	2.2193	3.6776
5	1.6123	2.1479	0.1970	1.7470	2.5488
6	1.7273	2.0604	0.1962	1.6613	2.4595
7	1.7399	2.5532	0.2544	2.0356	3.0708
8	1.9192	2.5532	0.2544	2.0356	3.0708
9	1.5366	2.5532	0.2544	2.0356	3.0708
10	2.4846	2.7394	0.3292	2.0697	3.4092
11	2.7749	2.7157	0.3329	2.0384	3.3929
12	2.0263	1.6534	0.2476	1.1497	2.1571
13	2.2195	1.6824	0.2415	1.1910	2.1738
14	3.4431	3.9058	0.3657	3.1617	4.6499
15	2.7400	2.8120	0.3724	2.0544	3.5696
16	1.0672	1.7843	0.5243	0.7175	2.8511
17	2.4202	3.7044	0.3541	2.9839	4.4248
18	3.4411	3.8994	0.3661	3.1546	4.6442
19	1.0695	0.6704	0.3720	-0.0865	1.4273
20	5.9020	4.7553	0.4332	3.8739	5.6367
21	3.9514	3.7044	0.3541	2.9839	4.4248
22	7.7215	4.7297	0.4284	3.8582	5.6012
23	2.4929	4.7553	0.4332	3.8739	5.6367
24	5.7297	3.7044	0.3541	2.9839	4.4248
25	2.7497	2.7952	0.3735	2.0354	3.5551
26	1.3528	1.4865	0.2869	0.9029	2.0702
27	1.5244	2.5855	0.3558	1.8616	3.3094
28	2.7133	2.6804	0.3387	1.9914	3.3694
29	2.7599	2.7025	0.3812	1.9269	3.4781
30	2.7570	1.6043	0.2584	1.0786	2.1300
31	2.7416	2.6101	0.3511	1.8957	3.3245
32	0.3244	0.6247	0.3776	-0.1436	1.3930
33	3.3586	2.1450	0.1969	1.7443	2.5456
34	0.2804	0.6751	0.3715	-0.0806	1.4309

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

```
                                        Std Error   Student
Obs      95% CL Predict        Residual  Residual  Residual      -2-1 0 1 2

  1    -0.5053     4.2157     1.8065     0.966     1.870     |     |***   |
  2     0.5155     5.0386    -0.9827     1.021    -0.962     |    *|      |
  3    -1.5557     3.4162     0.1778     0.887     0.200     |     |      |
  4     0.6575     5.2394    -1.5722     1.006    -1.564     |  ***|      |
  5    -0.0606     4.3564    -0.5356     1.049    -0.510     |    *|      |
  6    -0.1477     4.2686    -0.3332     1.049    -0.318     |     |      |
  7     0.3206     4.7858    -0.8132     1.037    -0.784     |    *|      |
  8     0.3206     4.7858    -0.6340     1.037    -0.612     |    *|      |
  9     0.3206     4.7858    -1.0166     1.037    -0.981     |    *|      |
 10     0.4667     5.0122    -0.2548     1.015    -0.251     |     |      |
 11     0.4407     4.9906     0.0593     1.014    0.0584     |     |      |
 12    -0.5760     3.8829     0.3729     1.038     0.359     |     |      |
 13    -0.5443     3.9091     0.5372     1.040     0.517     |     |*     |
 14     1.6101     6.2015    -0.4627     1.003    -0.461     |     |      |
 15     0.5118     5.1121    -0.0720     1.000   -0.0720     |     |      |
 16    -0.6353     4.2040    -0.7171     0.930    -0.771     |    *|      |
 17     1.4162     5.9925    -1.2841     1.007    -1.275     |   **|      |
 18     1.6035     6.1954    -0.4583     1.003    -0.457     |     |      |
```

19	-1.6295	2.9703	0.3991	1.001	0.399	| | |
20	2.4115	7.0991	1.1467	0.976	1.175	| |** |
21	1.4162	5.9925	0.2471	1.007	0.245	| | |
22	2.3895	7.0698	2.9918	0.978	3.060	| |******|
23	2.4115	7.0991	-2.2624	0.976	-2.319	| ****| |
24	1.4162	5.9925	2.0253	1.007	2.011	| |**** |
25	0.4943	5.0961	-0.0455	1.000	-0.0455	| | |
26	-0.7623	3.7354	-0.1337	1.028	-0.130	| | |
27	0.2962	4.8747	-1.0611	1.006	-1.054	| **| |
28	0.4019	4.9588	0.0329	1.012	0.0325	| | |
29	0.3964	5.0087	0.0574	0.997	0.0575	| | |
30	-0.6302	3.8388	1.1527	1.036	1.113	| |** |
31	0.3238	4.8964	0.1315	1.008	0.130	| | |
32	-1.6790	2.9284	-0.3003	0.998	-0.301	| | |
33	-0.0635	4.3534	1.2136	1.049	1.157	| |** |
34	-1.6244	2.9747	-0.3948	1.001	-0.394	| | |

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

Obs	Cook's D
1	0.194
2	0.021
3	0.005
4	0.078
5	0.002
6	0.001
7	0.009
8	0.006
9	0.014
10	0.002
11	0.000
12	0.002
13	0.004
14	0.007
15	0.000
16	0.047
17	0.050
18	0.007
19	0.005
20	0.068
21	0.002
22	0.449
23	0.265
24	0.125
25	0.000
26	0.000
27	0.035
28	0.000
29	0.000
30	0.019
31	0.001
32	0.003
33	0.012
34	0.005

Regression Analysis of Land Uses O_W_MU data

The REG Procedure
Model: MODEL1
Dependent Variable: LD

Output Statistics

Dep Var Predicted Std Error

Obs	LD	Value	Mean Predict	95% CL Mean	
35	2.7573	1.6262	0.2535	1.1104	2.1419
36	2.7068	2.5868	0.3556	1.8634	3.3102
37	1.1095	1.3780	0.3156	0.7360	2.0200

Output Statistics

Obs	95% CL Predict		Residual	Std Error Residual	Student Residual	-2-1 0 1 2
35	-0.6060	3.8584	1.1311	1.037	1.091	| |** |
36	0.2977	4.8759	0.1200	1.007	0.119	| | |
37	-0.8867	3.6427	-0.2685	1.020	-0.263	| | |

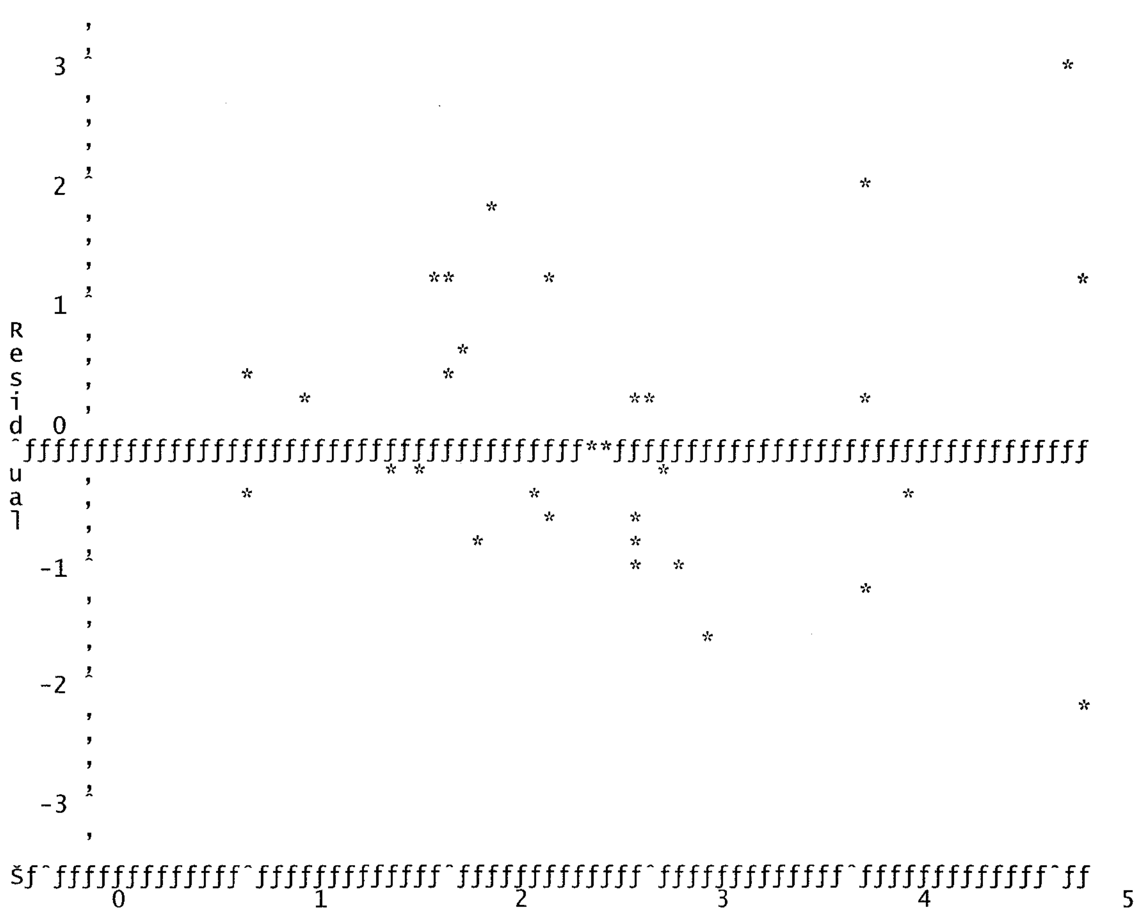
Output Statistics

Obs	Cook's D
35	0.018
36	0.000
37	0.002

Sum of Residuals	0
Sum of Squared Residuals	37.60343
Predicted Residual SS (PRESS)	49.91180

Regression Analysis of Land Uses O_W_MU data

Plot of resid*Pred. Symbol used is '*'.



```
                              Predicted Value of LD

NOTE: 6 obs hidden.

                    Regression Analysis of Land Uses O_W_MU data

                      Plot of resid*lsh.  Symbol used is '#'.

     ,
   3 ˆ                                                                        #
     ,
     ,
     ,
   2 ˆ                                    #
     ,                                    #
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     ,
   1 ˆ                                    #                                   #
R    ,
e    ,                                    #
s    ,                                    #
i    ,#                                   #
d  0
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ#ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ#ƒ
u    ,                                    #
a    ,                                    #                                   #
l    ,                                    #
     ,                                    #                                   #
  -1 ˆ                                    #
     ,                                    #
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     ,                                    #
  -2 ˆ
     ,                                                                        #
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     ,
  -3 ˆ
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      0                                   1                                   2

                                         lsh

NOTE: 16 obs hidden.

                    Regression Analysis of Land Uses O_W_MU data

                       Plot of resid*LD.  Symbol used is '*'.

         ,
       3 ˆ                                                             *
         ,
         ,
         ,
       2 ˆ                                              *
         ,                               *
         ,
         ,                        *   *                  *
       1 ˆ
    R    ,
    e    ,                     *
    s    ,          *      *
    i    ,          *          **         *
```

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d  0 ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ**ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
u    ‚               * *         *
a    ‚     *          *                 *
l    ‚                 * *
     ‚               *    *
 -1 ˆ                 ***
     ‚                          *
     ‚
     ‚                 *
 -2 ˆ
     ‚                           *
     ‚
     ‚
 -3 ˆ
     ‚
     Šƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒ
        0              2              4              6              8

                                     LD
```

NOTE: 6 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*inter1inv. Symbol used is '*'.

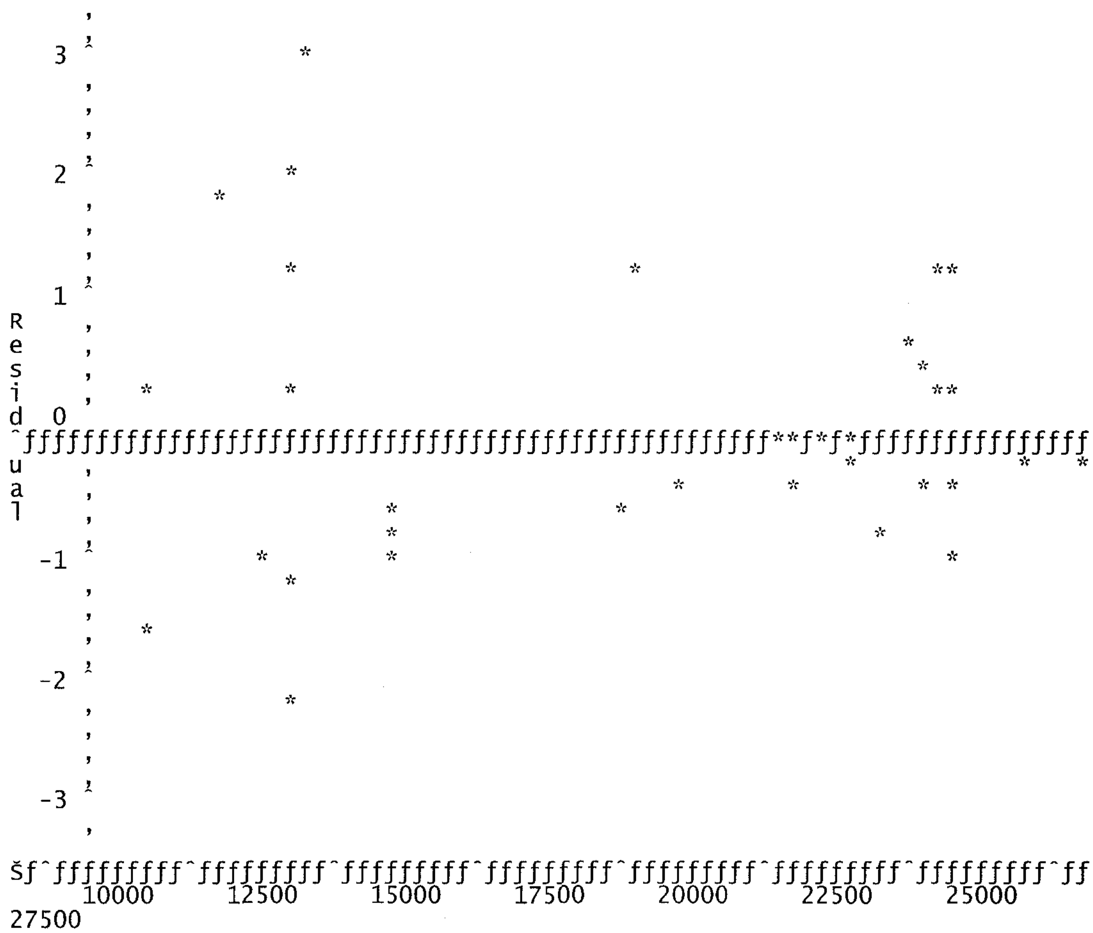
```
     ‚
   3 ˆ      *
     ‚
     ‚
     ‚
   2 ˆ      *
     ‚                         *
     ‚
     ‚
     ‚      *   *   **
   1 ˆ
R    ‚
e    ‚         *
s    ‚        *        *
i    ‚      *          **                                                 *
d  0
ˆƒƒƒƒƒ*ƒƒƒƒ**ƒ*ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
u    ‚       *   *       *
a    ‚         *     *    **
l    ‚        * *
     ‚        *   *
  -1 ˆ        *  *        *
     ‚      *
     ‚
     ‚                                                 *
  -2 ˆ
     ‚      *
     ‚
     ‚
     ‚
  -3 ˆ
     ‚
Šˆƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒ
    0.0         0.2         0.4         0.6         0.8         1.0
1.2

                                   inter1inv
```

NOTE: 2 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*inter2. Symbol used is '*'.

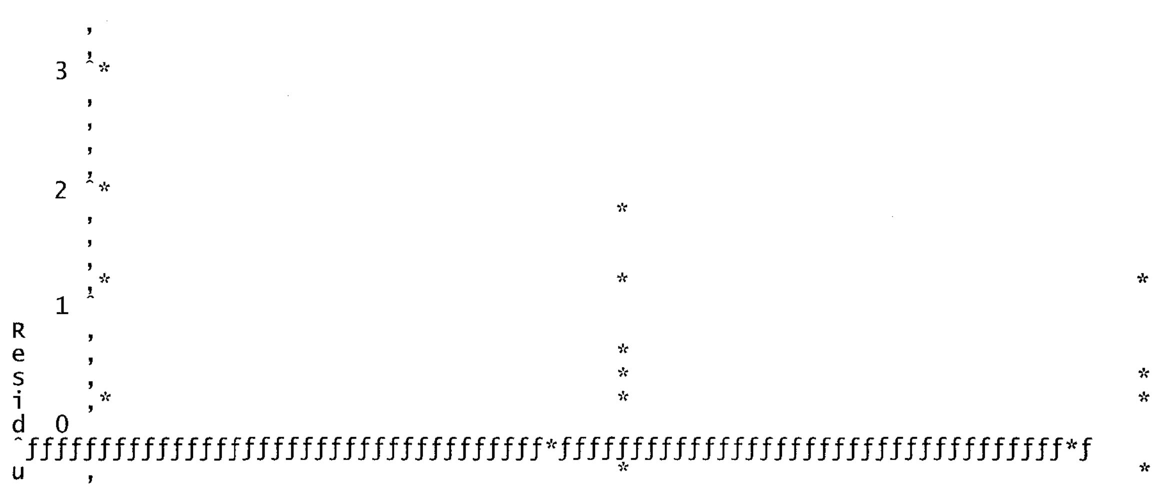


inter2

NOTE: 3 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*CBD. Symbol used is '*'.



```
a     ,                                    *                                    *
l     ,*                                   *
      ,*                                                                        *
  -1 ˆ*                                    *
      ,*
      ,
      ,                                    *
  -2 ˆ
      ,*
      ,
      ,
  -3 ˆ
      ,
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
      0                                    1                                    2

                                          CBD
```

NOTE: 10 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*adjlu. Symbol used is '*'.

```
      ,
   3 ˆ                                     *
      ,
      ,
      ,
   2 ˆ                                     *
      ,                                    *
      ,
      ,
      ,*                                   *                                    *
   1 ˆ
R     ,
e     ,                                                                         *
s     ,                                    *                                    *
i     ,                                    *
d  0 ˆ
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ*ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ*ƒ
u     ,*                                   *
a     ,                                    *                                    *
l     ,                                    *                                    *
      ,                                    *
  -1 ˆ                                     *                                    *
      ,                                    *
      ,
      ,                                    *
  -2 ˆ
      ,                                    *
      ,
      ,
  -3 ˆ
      ,
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
      0                                    1                                    2

                                         adjlu
```

NOTE: 13 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*adjrd. Symbol used is '#'.

```
          ,
        3 ˆ  #
          ,
          ,
          ,
        2 ˆ  #
          ,  #
          ,
          ,
          ,  #                                                #
        1 ˆ
R         ,
e         ,                                                   #
s         ,  #
i         ,  #                                                #
d       0 ˆff#ffffffffffffffffffffffffffffffffffffffffffffffff#ff
u         ,  #                                                #
a         ,  #                                                #
l         ,  #                                                #
          ,  #                                                #
       -1 ˆ  #                                                #
          ,  #
          ,
          ,  #
       -2 ˆ
          ,  #
          ,
          ,
       -3 ˆ
          ,
          Šffˆffffffffffffffffffffffffffffffffffffffffffffffffˆff
             1                                                2

                                  adjrd
```

NOTE: 13 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*corlt. Symbol used is '&'.

```
     ,
  3  ˆ                                                                        &
     ,
     ,
     ,
  2  ˆ                                                                        &
     ,&
     ,
     ,
     ,                                    &                                   &
  1  ˆ
R    ,
e    ,                                    &
s    ,&                                   &
i    ,&                                                                       &
d  0
ˆffffffffffffffffffffffffffffffffffff&ffffffffffffffffffffffffffffffffffff&f
u    ,                                    &                                   &
a    ,&                                   &                                   &
l    ,                                    &
     ,&                                   &
 -1  ˆ                                    &                                   &
     ,                                                                        &
```

```
     ‚
     ‚                                    &
  -2 ˆ
     ‚                                                                            &
     ‚
     ‚
  -3 ˆ
     ‚
Šˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒ
     0                                    1                                    2

                                        corlt
```

NOTE: 12 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*distch. Symbol used is '$'.

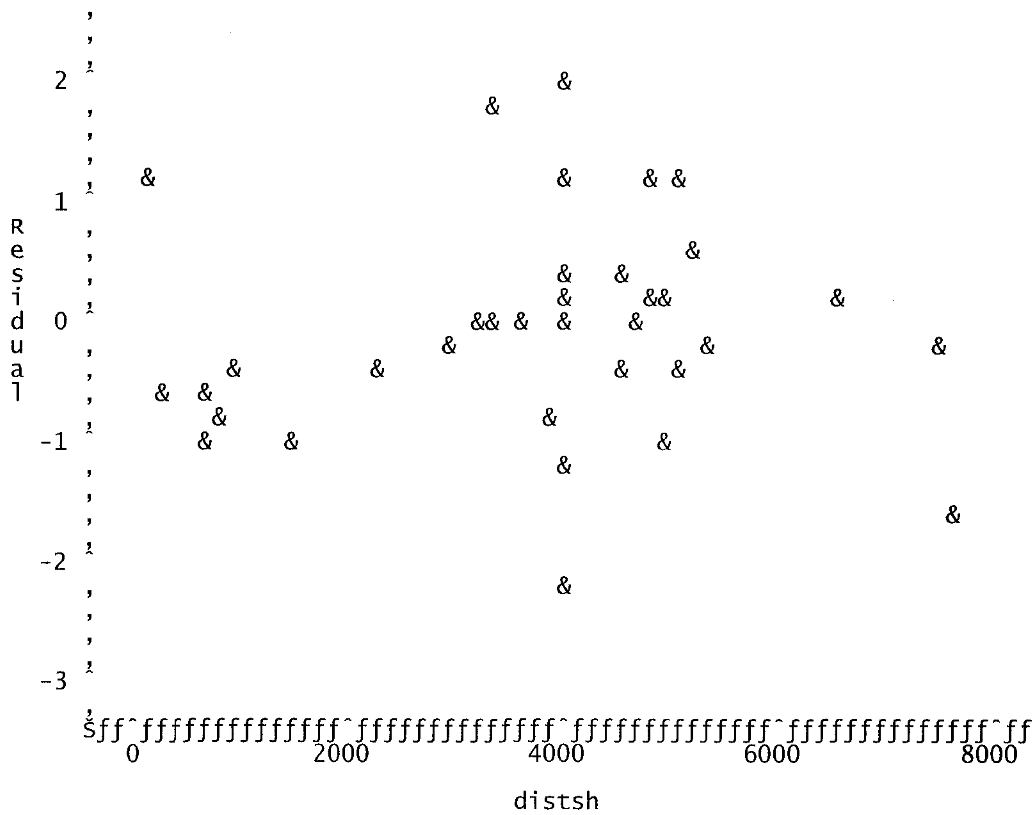
```
     ‚
   3 ˆ                  $
     ‚
     ‚
     ‚
   2 ˆ                           $
     ‚                                $
     ‚
     ‚
     ‚               $                  $ $                              $
   1 ˆ
R    ‚
e    ‚                                     $
s    ‚                             $$
i    ‚               $                  $$             $
d  0 ˆ
ˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ$$$ƒ$ƒƒƒ$ƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒƒ
u    ‚                       $                 $       $
a    ‚     $         $$              $    $
l    ‚        $     $
     ‚             $            $
  -1 ˆ               $  $              $
     ‚               $
     ‚
     ‚                                                 $
  -2 ˆ
     ‚                 $
     ‚
     ‚
  -3 ˆ
     ‚
Šˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒˆƒ
     0          2000        4000        6000        8000       10000
12000

                                        distch
```

Regression Analysis of Land Uses O_W_MU data

Plot of resid*distsh. Symbol used is '&'.

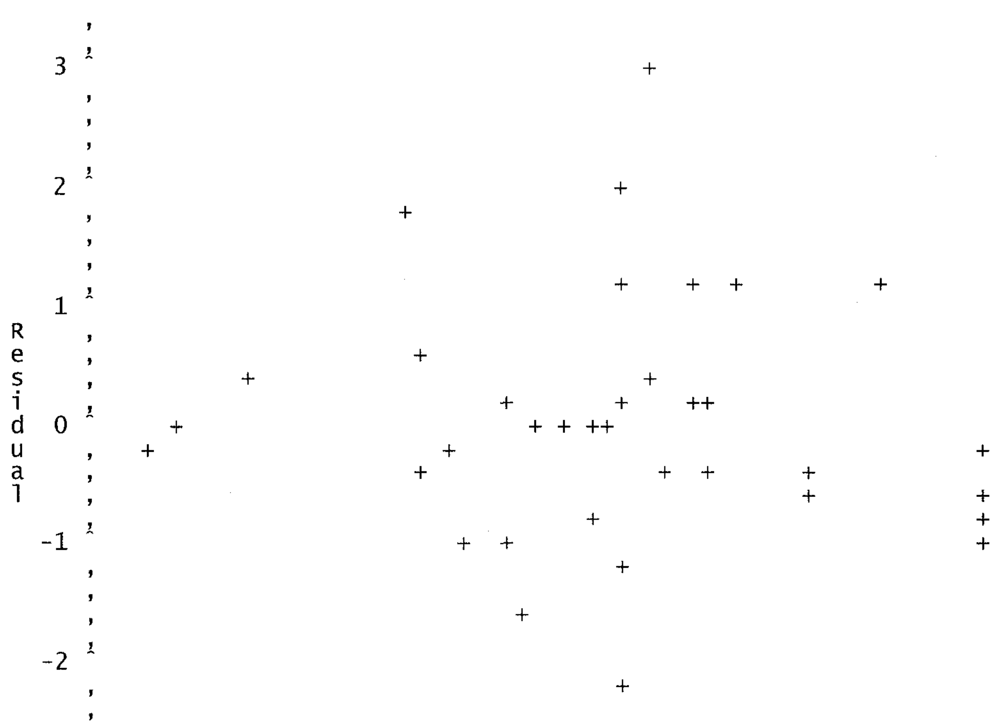
```
     ‚
   3 ˆ                                    &
     ‚
```



NOTE: 1 obs hidden.

Regression Analysis of Land Uses O_W_MU data

Plot of resid*distpk. Symbol used is '+'.



```
 -3 ˆ
    ˆ
    Šƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒƒƒƒƒƒƒƒƒƒƒƒƒˆƒƒ
     2000           4000           6000           8000          10000

                                  distpk

NOTE: 1 obs hidden.
```

Regression Analysis of Land Uses O_W_MU data

The UNIVARIATE Procedure
Variable: resid (Residual)

Moments

N	37	Sum Weights	37
Mean	0	Sum Observations	0
Std Deviation	1.02202724	Variance	1.04453968
Skewness	0.69042994	Kurtosis	1.37768447
Uncorrected SS	37.6034286	Corrected SS	37.6034286
Coeff Variation	.	Std Error Mean	0.16802024

Basic Statistical Measures

Location		Variability	
Mean	0.00000	Std Deviation	1.02203
Median	-0.07199	Variance	1.04454
Mode	.	Range	5.25421
		Interquartile Range	0.90845

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	0	Pr > |t|	1.0000
Sign	M	-1.5	Pr >= |M|	0.7428
Signed Rank	S	-34.5	Pr >= |S|	0.6095

Tests for Normality

Test	--Statistic---		-----p Value------	
Shapiro-Wilk	W	0.957526	Pr < W	0.1685
Kolmogorov-Smirnov	D	0.134214	Pr > D	0.0903
Cramer-von Mises	W-Sq	0.12225	Pr > W-Sq	0.0548
Anderson-Darling	A-Sq	0.663086	Pr > A-Sq	0.0807

Regression Analysis of Land Uses O_W_MU data

The UNIVARIATE Procedure
Variable: resid (Residual)

Quantiles (Definition 5)

Quantile	Estimate
100% Max	2.9918177
99%	2.9918177
95%	2.0253152
90%	1.2136130
75% Q3	0.3728829
50% Median	-0.0719932
25% Q1	-0.5355692
10%	-1.0610570
5%	-1.5721774
1%	-2.2623969

```
0% Min          -2.2623969
```

Extreme Observations

------Lowest-----		-----Highest-----	
Value	Obs	Value	Obs
-2.26240	23	1.15274	30
-1.57218	4	1.21361	33
-1.28415	17	1.80652	1
-1.06106	27	2.02532	24
-1.01660	9	2.99182	22

Regression Analysis of Land Uses O_W_MU data

The UNIVARIATE Procedure
Variable: resid (Residual)

```
Stem Leaf                     #             Boxplot
   3 0                        1                0
   2
   2 0                        1                0
   1 8                        1                0
   1 1122                     4                |
   0 5                        1                |
   0 011112244                9             +--+--+
  -0 43333110                 8             *-----*
  -0 876555                   6             +-----+
  -1 3100                     4                |
  -1 6                        1                |
  -2 3                        1                0
     ----+----+----+----+
```

```
                         Normal Probability Plot
 3.25+
     |                                                        *   +
     |                                                    *  +++++
     |                                                  *++++
     |                                           **+**+
     |                                       +++*+
     |                                  +*******
     |                            ********
     |                        *****+
     |                   *+**++
     |               ++*++
-2.25+  +++*+
      +----+----+----+----+----+----+----+----+----+----+
          -2        -1         0        +1        +2
```